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RADIO FOR THE MILLIONS

RADIO
FOR THE MILLIONS

BY

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THE POPULAR BOOK DEPOT
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TO

THE MEMORY

OF

MY UNCLE

LATE MAJOR V. M. PHATAK

who inspired in me an interest towards

RADIO

in the year 1928

by asking me to service his battery set

IN DEFENCE

(FIRST EDITION)

This book has been written exclusively for the numerous listeners who possess increasing aptitude for knowing all about the radio set they use, and, therefore it does not claim to be either a highly technical treatise on radio communication or an elementary radio primer. All thoughts of learning the science of radio engineering through the medium of this book should atonce be removed because it is not the type of book required for such study. The very primal consideration that induced me to write this book was to acquaint fully the average listener with such knowledge as would equip him to understand the radio receiver.

During the seven years of my experience in radio business I have had innumerable opportunities to come across listeners and persons who longed to read a book that would give them complete information about radio transmission, radio reception, radio receivers etc. in a most non-technical and easily understandable language. Such persons naturally have no desire to study either the laws governing the radio engineering or the minutest constructional details of a radio set. They merely desire such comprehensive information about the radio as would satisfy their one and all curiosities about it. Some of the persons are found to be curious enough to know how relays and commentaries are arranged, whereas others want information leading to a clear understanding of the terms Megacycles, Kilo-cycles and Metres. Certain groups of listeners cherish a desire to obtain information on the correct and proper

way of operating a radio, while there are many who scratch their heads on matters pertaining to 'Tuning' and 'Short Waves'. These are but a few cases, out of a multitude, that set the bell ringing for a type of book like this.

Therefore, the purpose of this book is to enlighten the listener on all points that strike his imagination and arouse his curiosities about a radio.

In preparing this book, special care has been exercised to see that the entire book is kept well-nigh within the limits of non-technical yet enough self-explanatory language. Very simple mathematics has been sparingly used wherever it was found absolutely necessary.

I hope this book will prove very helpful to millions of radio listeners who do not like too much theory but who, nevertheless, are extremely eager and curious to know many things about 'how the radio works' and perhaps more important still, the way to take out the best from a radio set.

I wish to express my thanks, to the management of Bombay Vaibhav Press for the promptness and care in printing this book, to Mr. Kelkar of Art Corner for almost all the diagrams in this book, to Mr. S. K. Murthi for the cover design and to Bombay Process Studio for the processing of all blocks of this book.

5th May 1941
BOMBAY

R. K. PHATAK

PREFATORY NOTE

(SECOND EDITION)

Seven years have elapsed since the first edition of this book was put into type. Though the appearance of this second edition had been hastened by the quick consumption of the first edition, it had to be delayed chiefly due to scarcity of suitable printing paper during the last several years.

The growing radio-mindedness in this country and the speedy development of broadcasting in India have established—rather empahsised the need for such books. In an attempt to enlarge the scope of the present edition the author has carried out an extensive revision and has provided two new and useful chapters: 'Life of a Radio Set' & 'Check up the Radio.'

It is hoped that the value of the book to the listeners and readers will prove to have been enhanced by this revision.

17-1-1948 POPULAR BOOK DEPOT
Bombay

The Paper And Binding Of This Book Conform To The National Economy Standards.

CONTENTS

CHAPTER I

RADIO—WHOSE INVENTION ?

Contrary to the public belief, Marconi is not the only inventor of modern radio. As a matter of fact, to attribute the invention of radio to the efforts of Marconi or any other single man, will be a sheer injustice to the memory of many other scientists without whose zeal, diligence and intelligence, radio may not have seen the light of the day. Radio is not one complete invention in itself but has sprung up as combination of many inventions. Naturally, therefore, credit has to recorded in favour of those scientists whose inventions remarkably contributed to the perfection of radio in its complete form.

Radio is a fruit of intelligent research diligently carried out by no single individual, but many. Of all these individual scientists, the name of the famous inventor Michael Faraday stands foremost because it was he who first conceived the 'Theory of Electro-Magnetic Induction' which has proved very instrumental not only in the invention of radio but many others.

Faraday worked day and night to substantiate his claims about the theory but it was not till the year 1830 that he could do so to his satisfaction. Theory of Electro-Magnetic Induction is the heart and soul of

the radio. Thirty four years later i. e. in the year 1864 there came about a scientific revolution when the Theory of Electro-Magnetic Waves was propounded before the world by that eminent scientist James Clerk-Maxwell. In reality, Maxwell more or less supported Faraday's theory with clean-cut mathematical calculations and the cobweb of doubt and spurn which hung around Faraday's research was set aside once for all. But this was all on paper so far. It was not until 1888 that these theories went into experimental stage. In this year Mr. Henrich Hertz, a German scientist, experimented on Maxwell's theory and diligently carried out experiments in the laboratory, with the result that his work attracted the very closest attention of all the front-line scientists of the world. Mr. Hertz's work mainly centred around the experiments on the speed of 'Electro-Magnetic Waves' and his research has been of so high a standard that Electro-Magnetic Waves are often called as "Hertzian Waves." In German Radio Literature, instead of using the word 'kilocycle' to indicate the frequency, it will be noticed that the word 'kilohertz' is being very freely used. But with all this brilliant success and utmost honour to his credit, Hertz did not achieve what Marconi could. It was the ingenuity and indefatigable research of Marconi which proved that Hertz's discovery can be put to everyday use, with advantage.

This important phase of radio research made Marconi climb the pinnacle of fame and glory very

easily. Marconi was acclaimed thousand times more famous than his predecessors though their contributions to this science had been as great, as helpful and as important as those of Marconi's. Since Marconi utilized this research for the benefit of the humanity it is no wonder if his name is always mentioned in lime light and those of Faraday, Maxwell and Hertz remain in the background. It will certainly be doing unpardonable injustice to the memory of Faraday, Maxwell and Hertz to refer Marconi alone, as the inventor of radio; because radio is not one man's invention but Faraday, Maxwell and Hertz have equal right over it, if not more than Marconi. In the year 1901 world's first Wireless Message was successfully transmitted by Marconi from Cranwal to St. Jones in Newfoundland, and, it became known for the first time to the world that wires were no longer necessary for transmission of messages. But all this certainly does not mean that Marconi alone should be honoured as 'Father of Radio'. Precisely, he is not. Besides Faraday, Hertz, Maxwell and Marconi there are many more names that have to be linked with Radio.

If Graham Bell would not have invented the telephone in the year 1876 or Edward Hughes the Microphone in the year 1878, one does not feel sure whether any word as Radio would have existed today. Similarly, we owe a great deal to the inventive ingenuity of Edison without whose research, which is known as 'Edison Effect', Radio would not have developed so

rapidly. The 'Edison Effect' has an important bearing on the development of modern radio valves. In the year 1890 Fleming invented the two-electrode valve which was followed up by the three-electrode valve perfected by Dr. Lee DeForest in the year 1907. Mr. A. Meissner, of German Telefunken Company, used the valve for the first time, as an oscillator, in the year 1913. This in itself was a great stride in the speedy development of radio. Federson in the year 1900 completed the 'High Frequency Alternator' and in May 1897 Sir Oliver Lodge patented the 'Principles of Tuning on which is based the tuning of modern radio sets.

It is to be proudly mentioned here that the late Indian Scientist Sir Jagadish Chandra Bose has also contributed much to the radio research and his work on coherers and magnetic detectors has been monumental.

Everything went well so far, and the reception of signals without wires became an established fact. The only drawback, that attracted the thought and attention of the scientists, was the poor reception of weak signals. Due to the poor sensitivity of the coherer and magnetic detectors, then in use, the range of transmission was vary limited, and, to counteract this dfficulty the scientists thought of two possible solutions. One was to improve the transmitter and the other was to develop an efficient receiver.

Mr. R. A. Fessenden, an American Engineer, who later developed wireless signalling in America, was

the first to propound the great idea of utilizing the beat frequency phenomenon in wireless communication. Fessenden's idea covered the simultaneous transmission of two frequencies which differed by a low frequency, so that if these two frequencies were combined at the receiver, an audible beat would be produced. Later on Fessenden's observations diverted to the usual single wave transmissions together with the producing of an audible beat in the receiver by causing a locally generated high frequency current in the receiver to interact with the transmitted frequency. This method of reception of wireless signals, is called the Heterodyne Method. Heterodyne is a word which is derived from two Greek words Heteros (other or external) and Dynamis (force). For want of suitable local generator of high frequency current, Fessenden's heterodyne system of reception could not be further developed for several years. But with the advent of Meissner's Valve Generator in 1913, the interest in the heterodyne method was immensely stimulated and during the same year Captain H. J. Round invented the Autodyne Circuit. The autodyne circuit could not be fully developed due to the outbreak of the World War 1 in the following year.

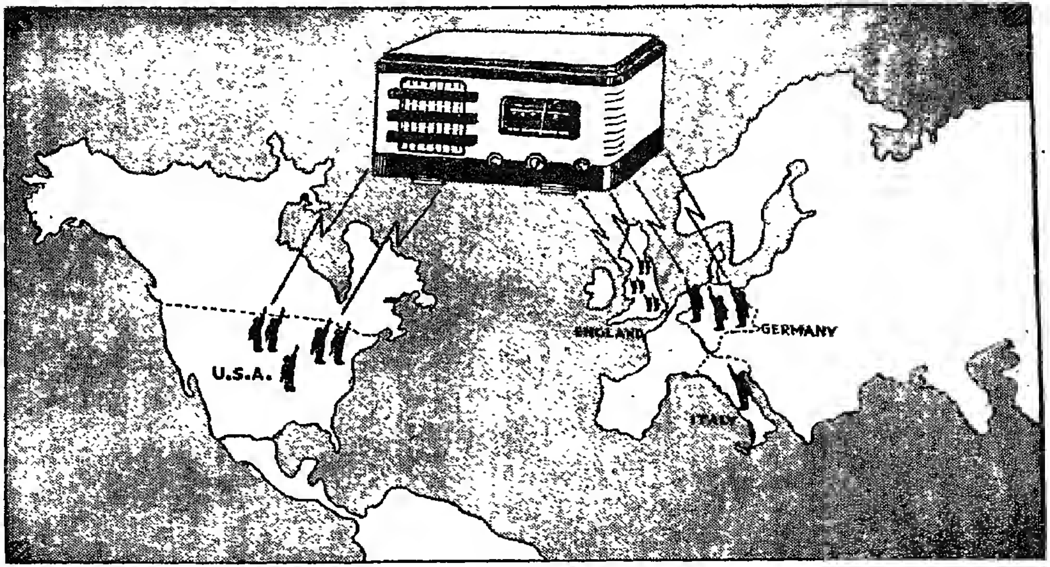
Extensive radio research, from the view-point of war, was being carried out both by Germans and Allies. Both very acutely felt the necessity of receivers which could give high amplification. It was then, that Major E. H. Armstorng of American Expenditionary Force, which was then on the Allied Front, came forward with

his revolutionising Principle of Superheterodyne Reception. Major Armstrong was the first to develop this system of reception utilizing the Principle of Superhetrodyne. However, Mr. W. Schottky of Simens Laboratory in Germany, was the first to describe a superhetrodyne in early 1918 but Major Armstrong not only conceived this very idea—a mere coincedence—but actually put it in practical use by constructing an eight valve superheterodyne receiver.

The signing of the armistice temporarily suspended further experimental work for a few years and it was not till 1930 that the Superheterodyne Receiver could establish itself as a popular receiver. And what do we find to-day ? The receiver of to-day, be it any make, is necessarily a Superhet.

It is due to Superhet Receiver alone that it has been possible to hear the crowded and weak transmissions. It would be no exaggeration to say that the thousands of transmitters, now in use all over the world, owe their existence to the Superhet Receiver invented by Major Armstrong. After the Superhet established itself as the popular receiver, many refinements were carried out in it after 1933. These refinements include changes in the Mixer Stage, I. F. Stage, Driver Stage, Output Stage and even the Power Supply. And the only serious defect from the listener's point of view, that still remained in the Superhet, was the reproduction of extraneous noises along with the programmes. Research was directed

towards the elimination of the static interference and many types of static suppressors, anti-static aerials and so many other gadgets, claiming to give static-free reception, were rapidly introduced in the market. But the serious defect, with all such gadgets, had been that along with the reduction in static interference there was also evidenced a reduction in signal volume, thereby lowering of the overall sensitivity of the receiver. This was considered a very serious defect from the view point of the listener. Naturally, the direction of the radio research drifted towards exploring means and methods for the complete elimination of the extraneous noises. And as before, that world-famous veteran of the Superheterodyne fame Major Armstrong came on the scene with his revolutionary invention of 'Frequency Modulation'. Major Armstrong's invention of Superheterodyne in 1913-14 proved revolutionary as far as the Radio Receivers were concerned but this time his invention has revolutionised not only the receivers but transmitters as well. Fundamentally speaking "Frequency Modulation" is a research directly affecting the transmitters and indirectly the receivers. Because, when the present Amplitude Modulated Transmitters are replaced by Frequency Modulated Transmitters, the Amplitude Modulation Receivers, now in use, will have to be replaced by receivers designed to receive Frequency Modulated Transmissions. It is a very strange coincidence that Major Armstrong's both the revolutionising radio inventions have been put before the world when



Picture showing different nations which greatly contributed to the development of Radio

the world was at war. At the time of Superhet Invention the World War 1 was on and it did hinder the development and spread of receivers designed on the superheterodyne principle. And similarly, even though the Frequency Modulation had been adopted in U.S.A. to a certain extent, on experimental license; World War 2 checked to a great extent, the speedy commercialisation of F. M. Transmissions on a large scale. Therefore, we in India may have to wait longer to hear the static-free programmes from our own stations.

To explain what is Frequency Modulation, is beyond the scope of this book. It is enough to note that Frequency Modulation makes possible the reception of programmes without any accompaniment of noises and crashes that we hear at present.

CHAPTER II

HOW PROGRAMMES ARE TRANSMITTED

Even a little child knows that we get light from the Sun and that we hear a loud thunder when a cannon is fired. Let us then try to visualise the mediums which enable us to hear the sound and see the light.

Just as water has waves, sound and light too have waves. When the vocal chords of a human being or the explosion of the charge in a cannon, strikes the air, sound waves are created in just the same manner in which a stone dropped in a pool of water creates and sends water waves out and away over its surface. These sound waves travel through the air and on reaching us they strike the diaphragm of our ear where a delicate mechanism connecting our ear to brain, carries the sensatoin to the latter and we say "that is a human voice" or "that is a cannon fire". Everyone knows that we are surrounded by air because we breathe air and can blow out a candle or inflate a football with it. It is through this air that the sound waves travel. The fact that these sound waves travel through air can be easily substantiated by an "easy to arrange" demonstration. An electric bell should be placed inside a glass jar, as in Fig. 1 B, from which all air has been taken away creating a perfect vacuum in the jar. The bell is connected to the battery. If the press-button is now pressed, our eyes will only see

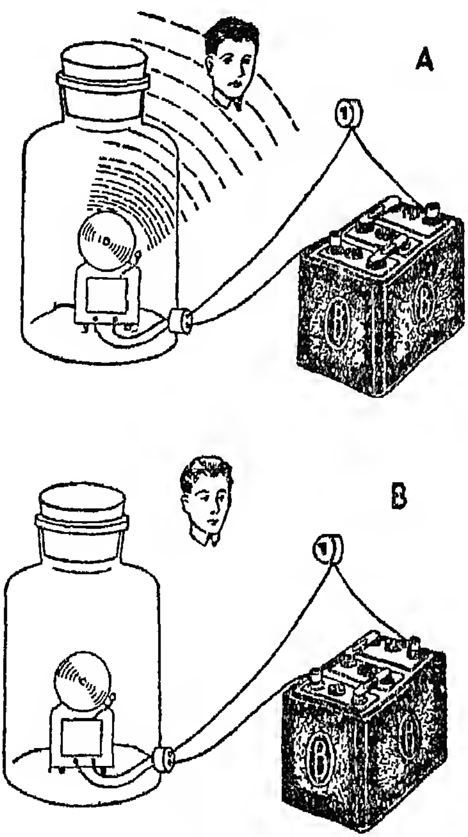


FIG. 1

the fast movement of the clapper striking the bell. But do our ears hear the ringing of the bell ? Not at all. We do not hear anything. Now let us take out the cork, admit air inside the jar and recork it (Fig. 1 A). The pressing of the press-button will now reveal to our ears that the sound of the bell can be heard. After studying this demonstrative proof, let us have no doubts about the statement that it is the air through which the sound waves travel or it is the air alone that conveys us the sound.

As against this and in striking contrast to the behaviour of sound waves, the light waves do not travel through air. It is not the air that conveys the sensation of light and shade to our eyes. If we suppose for a moment that the light waves or the light travels through the air, we have reason to doubt the correctness of this supposition, because we get light from the Sun even though there is no air around the Sun—a fact established by science. Similarly, in the electric bulb, which we daily use, we find another proof to show that light waves do not travel through air. It is an every day fact which everyone knows, that electric bulb has no air inside it. If the electric bulb had air inside, the filament would burn out immediately due to the proportion of oxygen in the air. If this electric bulb, from which all air has been evacuated, can give us light, it does occur to us at once that air is not at all necessary for the light waves to be carried. Having thus taken for granted that air is not the medium through which light travels,

curiousity strikes our imagination to know what is that medium which enables the light of the electric bulb or the Sun, to reach us. It will not be required to stretch our imagination too much to know that there must be then something besides air that carries light waves to us, because it is a fact that we get light irrespective of the presence of the air. The great scientists now come to our help and they tell us that all matter is permeated by a substance called ETHER which has no weight, which cannot be seen, felt or detected in any way. Ether is everywhere, all around, above, below, in our bodies and other things as well.

All material things on this earth are made up of very very small particles and though such particles of matter have been combined to make a wooden door or a stone wall, the latter appear apparently solid things but in reality they are solid things having enough gap-which is not visible to the human eye—for a thin substance like Ether to go through and penetrate it. Just imagine that we are seeing a thick forest from a far off distance, when all the leaf is off the trees. What do we see? Nothing but wood. The trunks of the trees are seen everywhere. Some trunks are nearer to us and others are away from us. But the space between the trees that are nearer to us, apparently seem to be filled by trees that are further away from us. In short the forest gives us an appearance of one solid log of wood, though we know, for certain, that there is plenty of space between the trees for us to walk about, for animals to run and hide and for the

birds to fly. In a forest we have only a few thousand trees but the wooden plank of the door or the wall of the house we live in, is made up of millions of very small particles, and just as the forest appears to us as a solid wood, the door or the wall appears to us as a solid thing, though between the million particles there is space enough for the Ether to go through. In much the same way as the air could pass through the forest which apparently looked like a solid log of wood with no intervening space, Ether can also pass through any matter—be it a wooden door or a stone wall—which apparently looks like a solid having no intervening space. The millions of very small particles of which the door or the wall or our body is composed of, leave ample space between themselves which is more than enough for a very very fine substance like Ether to pass through.

We have now understood enough about the substance Ether. It has been proved by the great scientists that the light waves travel through this substance Ether, in much the same way as the sound waves travel through air.

The light waves are nothing but a combination of electric and magnetic waves and since the electric waves are more akin to light waves, a theory, put forth by the scientists, was accepted that Electro-Magnetic waves travel only through ether, as light waves do.

Now let us for a moment study the behaviour of sound waves through air. From everyday experience we

know one very striking phenomena about the sound waves. The sound waves travel through air but they become weaker and weaker as the distance they have to travel becomes more and more. Sound waves cannot reach long distances without becoming weak. For example, a whisper is heard only a few feet away and not any more. A human voice is not heard at all beyond say hundred feet, unless the man shouts. And even a shout of a man is not audible beyond a few hundred feet. Engine whistles or the church bells too, have a limit of audibility, beyond which they are not heard at all. If such is the peculiar phenomena by which the sound waves are governed, how Churchill from England, Stalin from Russia and Truman from U. S. A. can be heard in India which is so many thousand miles away from these places? Apparently, it is a very difficult question to answer, but the great scientists have already provided an answer to this question. These scientists say that unlike sound waves, the electro-magnetic waves can reach long distances without becoming much weak. They further say that just as a weak man who cannot walk long distances without becoming weak, can be carried to long distances by an aeroplane, similarly, the sound waves which cannot travel long distances without becoming weak can be carried to long distances by the Electro-Magnetic Waves. After much valuable experimental research it was found that the electro-magnetic waves could be used "to carry" the sound waves over long distances.

As an analogy, let us suppose that a man is asked

to leave Calcutta at 8 a.m. one day and reach Bombay the same day by 12 noon. If the man were to decide in favour of running from Calcutta to Bombay, he will not be able to fulfil the contract, as he will become weaker and weaker as he runs more and more distance. A moment will then come when he may become senseless, due to fatigue and exhaustion or even his life may become extinct. But the man, being clever, engages an aeroplane 'to carry' him from Calcutta to Bombay within that specified period of four hours. This means that the aeroplane becomes the CARRIER of the man and crosses the Bombay-Calcutta distance in four hours, without allowing the man to become weak. In much the same way as the aeroplane can be called as the CARRIER of the man, the Electro-Magnetic Waves can be termed as "CARRIER" of Sound Waves. It is because of this nature of the work which these Electro-Magnetic Waves are called upon to do, that they are often times referred to as CARRIER WAVES. It might have been the experience of many listeners that they hear a peculiar gushing sound if they just switched on their receiver about five minutes before the time-signal. This peculiar sound is an indication that the CARRIER WAVES of that particular station are now generated and they are now ready carry to the sound waves.

In the case of the man and aeroplane, the latter is the CARRIER of the former and in the case of waves, the Electro-Magnetic Waves are the CARRIER of Sound Waves. Much in the same way as the man enters the

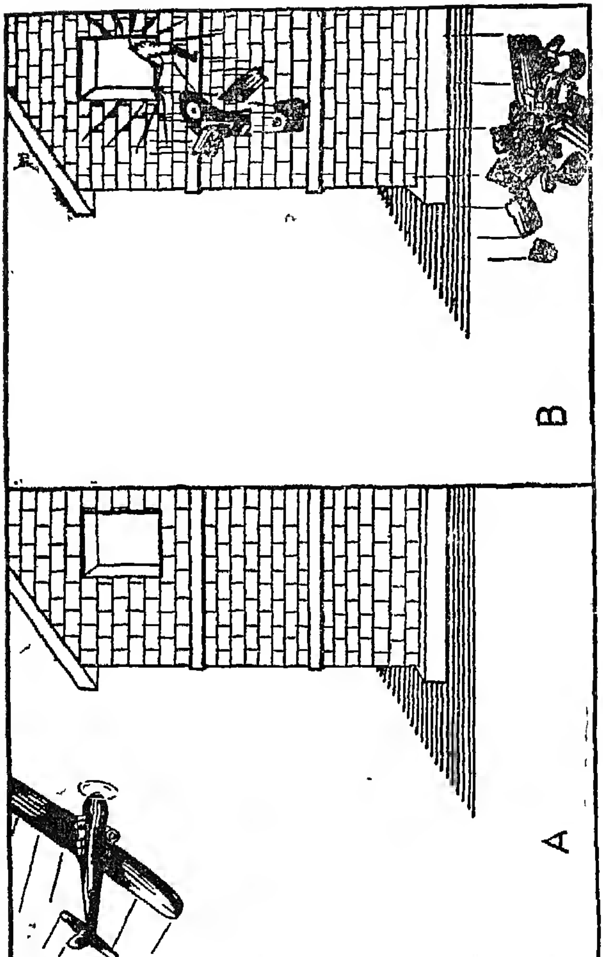


Fig. 2

At (A) is seen the aeroplane carrying the man and at (B) the man enters the house through the window, but the aeroplane is destroyed

aeroplane and it becomes a man-aeroplane combination, we can combine the sound waves and electro-magnetic waves; the only trouble being that the making of the latter combination is much more difficult than the former. We can neither make the sound waves sit on the electro-magnetic waves nor can we combine or mix them together. Just as lumps of salt cannot be properly mixed with the sugar powder, unless the lumps of salt are crushed into a powder form; similarly the sound waves cannot be combined with electro-magnetic waves unless they are converted or changed to some other form.

Edward Hughes's Microphone comes to the scene now. Many of us might have attended big public meetings and seen "a little thing" on a stand or table, into which the speaker speaks. Many of us must have used a telephone, and talked into "something." The 'little thing' in the public meetings or the "something" of the telephone is nothing but a microphone. When we speak into a microphone our sound waves or speech waves are transformed or converted into electric waves. And thus, the form of sound waves is changed to another form which can be readily combined with the Electro-Magnetic Waves *i. e.* Carrier Waves. Technically speaking this work of combining or mixing the converted sound wave and electro-magnetic wave is called 'Modulation', and the mixture of the two waves is called Modulated Waves.

These modulated waves (converted sound waves + electro-magnetic waves) which are equivalent to the

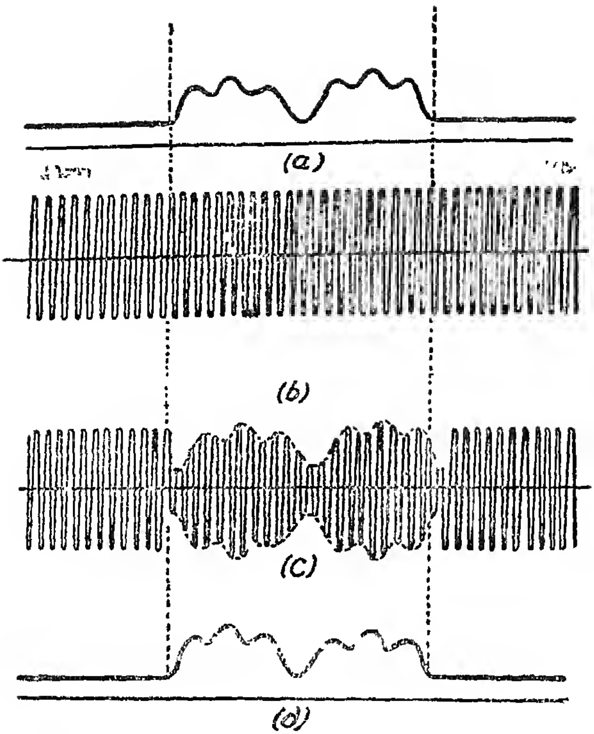


FIG. 3. In the above figure the curve at (a) is representing the converted sound wave. The man speaks in the microphone and his speech is changed by the microphone into electric energy which is represented by this curve. This electrical energy can now be easily mixed or combined with "Carrier Waves" shown at (b). The combination of (a) and (b) which is equivalent to 'Modulated Waves' is shown at (c), and this is the form of waves that strike the aerial. The radio set destroys the "Carrier Waves" and the original electrical waves (converted sound waves) are liberated which are shown at (d). A comparison between the curves at (a) and (d) shows that the form of electrical waves (converted sound waves) after demodulation, shown at (d), is exactly similar to the form before modulation, shown at (a).

combination of man and aeroplane in the above analogy, now start on the journey. These modulated waves, by nature, are just like Electro-Magnetic Waves and since they obey the same laws as the latter, they travel long distances without becoming much weak. These modulated waves start their "round the world" journey through the Ether. And these waves while running about here, there and everywhere, strike the aerial of our radio receiver and enter into it.

Let us now extend our man-aeroplane analogy and ask the man to reach Bombay and be present in a house to which the only entrance is a window 3×3 feet. The aeroplane carries the man upto the window and has to remain behind because the 3 × 3 feet window will be too small an entrance for the aeroplane to enter. So, the aeroplane or the carrier of the man has to remain behind and the window allows only the man inside (Fig. 2). As a matter of the fact the aeroplane is no longer required. The work of the aeroplane to carry the man, being now over, we do not want it inside the house. Likewise, the electro-magnetic waves *i. e.* the carrier waves, having completed the work of carrying sound waves to our Radio Set, are no longer required and can be done away with.

As the dimensional design of the window helped us in separating the man from the aeroplane, the design of our Radio Set helps us to separate the sound waves from the electro-magnetic waves. This work of separating these two waves is technically known as "Process of

Demodulation". Our radio set is so designed that it is capable of demodulating the modulated waves, and giving us only sound waves which when rushed into a loud speaker give us "SOUND".

We have learnt above that the sound waves had to be changed in form and converted to electrical waves before they could be combined with Electro-Magnetic Waves to form Modulated Waves. In reverse order we have to separate these electric waves from electro-magnetic waves and then we have to restore the original form of sound waves. The sound wave was changed to electrical wave by means of a microphone. And now the electric waves or impulses which are separated from electro-magnetic waves are taken to a LOUD SPEAKER, and here the electric waves are again changed back to their original form *i.e.* Sound Waves. And this is how we hear the sound.

So far we have learnt, in general outline, the many processes that are required for a sound wave to start from one end of the globe and reach the other end. Now let us go to a Transmitting Station and find out the actual things that are to be done to send the 'SOUND' away and everywhere.

On previous page you will find a complete picture of a studio and transmitting station. The artist is singing before a microphone. The sound waves of the artist are converted into electric waves by the microphone. By wires these electrical impulses are carried to another room

A, where these are amplified. After amplification, these electrical impulses or waves are taken to the room M in transmitting station, where the electro-magnetic waves or the carrier waves are generated. In this very room, the electric impulses or the electric waves are combined or mixed with the electro-magnetic waves, and the Modulated Waves, after further amplification, come out of this room through wires and then they go to the Transmitting Aerial. From transmitting aerial these modulated waves go out in the Ether. These waves travel in the ether and strike the aerial of our radio set and enter it through the lead-in wire.

Once the modulated waves enter our radio set, the process of demodulation takes place and we hear the sound. For carrying out this process of demodulation or separation we require so many different things in our radio set; and, what these things are, we are going to learn in the next chapter.

CHAPTER III

HOW PROGRAMMES ARE RECEIVED

In the previous chapter we just learnt how the song of an artist or the speech of a speaker is changed to electrical impulses or waves by the microphone; and, how these electric waves are combined with the electro-magnetic waves, to form what are known as 'Modulated Waves'. These modulated waves, while spreading about here, there and everywhere, strike the aerial and enter our radio set through the "lead-in wire"—this is the wire which connects the aerial to the radio. Now, we also know that to hear the sound from our radio set we have to see that process of demodulation *i. e.* the process of separating the sound waves from the Carrier Waves, takes place in our radio.

So the programme is right now in our set and the designer of the radio set has done his job so well that we have to operate only two or three controls to hear the cricket commentary or Nehru's speech or a song of an artist or the news. At this stage you may ask "Well! What are these controls and what actual work they have got to do?" Before knowing anything in details about these controls, let us have some idea about the different parts and components that go to make a complete radio set. It will interest you to see Fig. 4

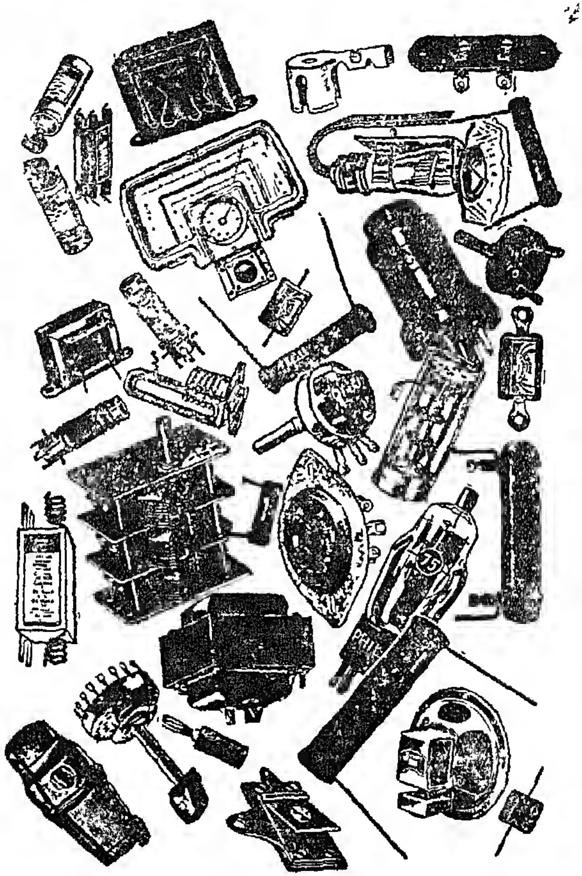


FIG. 4

where all the parts that are used in a radio set are shown disconnected. There are Condensers, Coils, Chokes, Dial, Chasis, Cabinet, Valves, Resistances, Tone Control, Volume Control, Pointer, Transformers, Bolts and Nuts, Wave-change Switch, Knobs, Loud Speaker etc. All these parts, when arranged and connected in a particular way, constitute our radio set. And mind you, each of these parts has been alloted some specific work; and when each part co-operates with the other and does its duty, the work of separating 'Sound Waves' from the Carrier Waves is successfully done and not otherwise.

At this stage let us try to understand something more about each part shown in the picture, and, learn the nature of the duty each has to perform in our radio set.

PARTS—A *MODERN* RADIO SET *MUST* HAVE

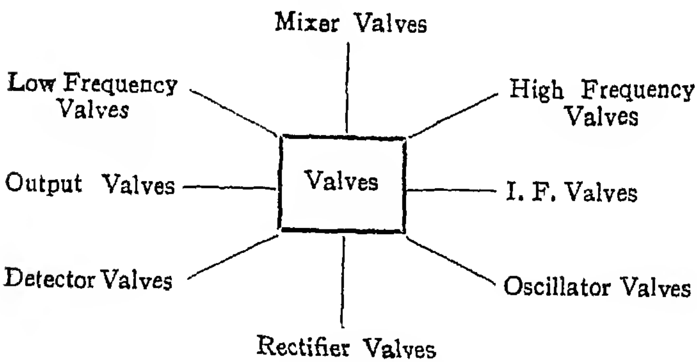
Valves	Dial Lamps
Resistances	Chasis
Screws, Nuts, Washers	Volume Controls
Condensers	Dial, Pointers
Chokes	Cabinet
Tone Controls	Wires etc.
Coils	Knobs
Transformers	Loud Speaker

Wavechange Switches

VALVES

This is the most important part in a radio set. It is this component around which the entire circuit of the radio is designed. In designing a radio set the first

thing the designing engineer has to do is to select the proper types of valves and then calculate and design the other parts in such a way that they help the correct operation of the selected valves. You will be surprised if you are told that there are about two hundred and fifty types of valves to-day, that have been designed and made available in the market. All these types of valves are divided in different groups and each group has to do some particular job. The figure below shows these different groups



HIGH FREQUENCY VALVES. When the modulated waves enter our radio set, these are sometimes taken to one or more high frequency valves. The modulated waves are made stronger by these types of valves. The adding in strength of waves is called 'Amplification'. The modulated waves are of a very high frequency and so we call them high frequency waves and, therefore, the work of strengtheing these high frequency waves is called 'High Frequency Amplification'. The valves used for the purpose of

high frequency amplification are termed as 'High Frequency Valves'. A moderately priced five valve radio set will not have a valve from this group but a good six valve or seven valve radio or more will necessarily have one or two valves from this group.

DETECTOR VALVES. The real term for this group is 'Demodulator Valves'. The term 'Detector Valves' though extensively used, is a misnomer. This group of valves is very important. The process of demodulating the modulated waves is done by this valve.

LOW FREQUENCY VALVES. The valves of this group are used immediately after the demodulator or detector valve. As has beed emphasised before, after demodulation only, the 'AUDIO WAVES', which are nothing but converted sound waves, remain in the circuit. These Audio Waves have a frequency generally not above 16000 cycles per second. The valves which add strength to these audio waves are called "Low Frequency Valves."

OUTPUT VALVES This is a group of valves to which belong the last one or more valves of our radio set. There must be one valve in each set and there can be two or more in some other set, which means that a set can have more than one output valve. This is the valve on which depends the output of our set. The loud speaker is connected to this valve or valves through an output transformer.

OSCILLATOR VALVES, MIXER VALVES, I. F. VALVES. These are the three groups of valves which are used in the superheterodyne radios. Each one of these groups is allotted a specific duty. The oscillator valve generates local high frequency waves in our

radio set, which are mixed with the incoming carrier waves by the Mixer Valve and the resultant intermediate frequency waves are amplified by the I. F. or Intermediate Frequency Valves. After the I. F. Valve or Valves comes the detector valve that has been already described above.

RECTIFIER VALVES. The valves belonging to this group supply the currents, voltages and power that is necessary for the operation of all the valves of our radio set.

CONDENSERS

The more appropriate name for this part is 'capacitor.' The name 'condenser' though widely used is a misnomer.

Condensers play a very important role in the performance of a radio set. A condenser consists of two conductors separated by an insulator. It has the property of storing electrical energy in the form of an electrostatic charge and returnnig the greater part of this energy to the circuit when the impressed voltage is removed. If you place two rupee coins, one over the other, and then separate the two by inserting a post card in between, you will have made a "condenser". The two rupee coins, being the conductors and post card the insulator. In radio condensers, aluminium or tin foil is extensively used as conductor and any of the following material is used as insulator. Insulator is termed as Dielectric.

(1) Air
(2) Mica
(3) Paper
(4) Certain Chemicals
(5) Oil
(6) Glass

In the above example the rupees will be the conductors and the post card the dielectric. But if you take away the post card and keep the coins in such a way that they do not touch each other then also a condenser will have been made. In this case the paper is not there as dielectric, but the 'air', which is between the two coins, is the dielectric. Similarly mica, chemicals, oil and glass can be used as dielectrics.

Having understood what is a condenser we will now try to know what the condensers do in our radio set. There condensers have to perform multifarious duties iu our radio set.

A CONDENSER CAN:

(*a*) Improve weak reception of the set
(*b*) Put an end to the tinny sound from your set
(*c*) Remove shrill whistles from your set
(*d*) Remove HUM from your set
(*e*) Eliminate motor-boating (peculiar sound similar to the sound of a motor-boat) from your set
(*f*) Minimise the electrical interference from your set
(*g*) Remove crackling from your set
(*h*) Remove fading from your set
(*i*) Make your set shock-proof
(*j*) Bring in different programmes from all over the world, in your set (when you tune a radio set with the knob provided, you actually rotate a condenser inside the set).
(*k*) Can improve the quality of reproduction

RESISTANCES

Just as condensers are used in connecting one valve to the other, so also resistances can be used to do this duty to a certain extent. Besides this, resistances are used in a sadio set for supplying proper voltages and currents to different valves, improving the tone of reproduction etc. These resistances are made of wire or carbon, and are of different sizes and shapes depending upon high or low resistance values.

COILS

This part of a radio set is extensively used for tuning purposes. When used in conjunction with a condenser, the combination provides facilities for tuning a radio set, to any station.

CHOKES

Chokes are used for eliminating hum from the radio set and checking or helping the passage of undesired or desired frequencies in a radio circuit.

TRANSFORMERS

There is a big family of transformers and each member of this family has been assigned a particular duty to perform.

Power Transformers. (Also called Mains Transformers.) They supply power to all the valves in a radio set. When the radio set plug is put in our house supply socket, we connect this power transformer to our mains.

OUTPUT TRANSFORMERS. These are used for connecting the last valve or valves (output valves) to the loud speaker.

I. F. TRANSFORMERS. These are used to connect one I. F. valve to other or the mixer valve to the I. F- valve or the I. F. valve to the detector valve.

COUPLING TRANSFORMERS. These are used for coupling (connecting) one valve to the other in audio stage.

VOLUME CONTROL

As the name implies, this part controls the volume of the radio set.

TONE CONTROL

It can change, at will, the tone of the reproduction *i. e.* when desired we can have more low notes or high notes by operating this control.

LOUD SPEAKER

As has been noticed before, the converted sound waves are liberated (demodulated) from the Carrier Waves by the detector or demodulator valve. These converted sonnd waves *i. e.* electrical impulses are amplified by one or more low frequency valves, and passed on to the loud speaker. The loud speaker changes these converted sound waves back to pure Sound Waves.

DIAL LAMPS

These are also called Pilot Lamps. Such lamps provide sufficient light on the dial, making the reading of it more convenient.

DIALS

These give us an indication as to which station has been tuned in. Such dials are calibrated either in 'frequency' or 'wavelength' or sometimes in both. In some cases they carry names of different stations as well.

WAVE—CHANGE SWITCHES

These are employed to switch on the radio to a particular wave band. For example while hearing "Bombay" on 244 meters, if it is desired to tune in 'London' on 19 meters, we cannot do it unless we operate the wave-change switch.

We have now learnt enough about the different components and parts that go to make our radio set. We know what are valves and what different types of duties they perform. Similarly, we know what are condensers and what part they play in the performance of our radio set. Likewise, we also know much about the different other parts and components used in a radio set.

Many of us must have seen a mechano. There are many different parts,of altogether different shapes and sizes from one another, in a mechano. There are wheels, pulleys, bolts, nuts, bars, pipes, strips, washers, screws etc.; but unless and until these different parts are connected in some particular way we will not be able to make a house or a pump or something else. Similarly, the different parts which we have studied above, have, to be connected in some particular way to make a three valve,

four valve or a ten valve set. In Fig. 5 you will see how these parts are connected to complete a three valve radio set. There are condensers, resistances, valves, loud speaker and all that we learnt above. The picture at the bottom shows a pictorial view *i. e.* the different parts are shown exactly as they look. And the picture at the top is a symbolic representation of the same. In technical language this symbolic representation is termed as 'Circuit Diagram'.

Of all these components or parts, all do not 'control' the performance of our set. No doubt all these parts contribute to the performance but they do not control it, at will. Usually there are not more than half a dozen components that actually control the performance of a radio set. By the words 'controlling the performance' it is meant controlling the volume, the tone, the selection of different stations and switching on or off. Let us call these components as 'Control Components' and these are:–

(1) 'On' and 'Off' Switch
(2) Tone Control
(3) Volume Control
(4) Wave Band Switch
(5) Tuning Condenser

'On and Off' Switch. This switch is invariably associated with the volume control or tone control. But in some radio sets there is an independent 'on' and 'off' switch. The operation of this switch either connects

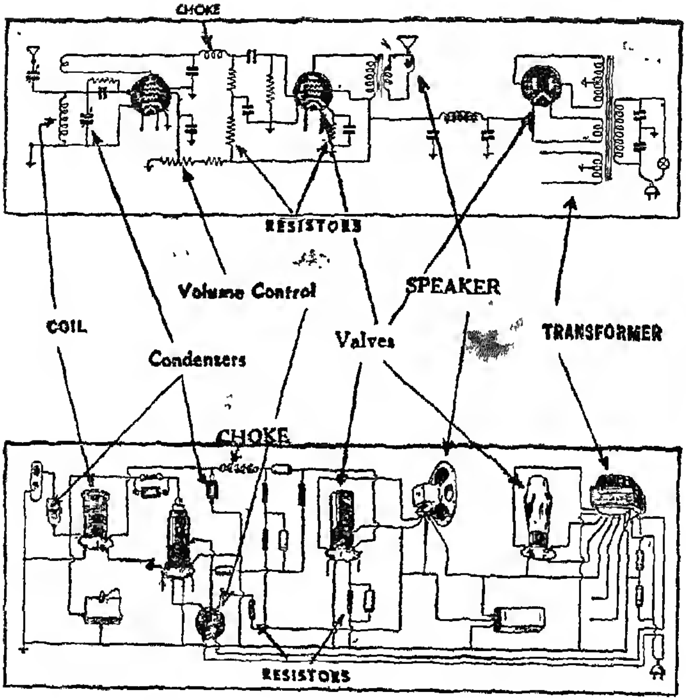


FIG. 5

Top portion is the circuit diagram and the bottom one is the pictorial representation of the same.

or disconnects the radio set from the electric supply in the house.

TONE CONTROL. This control affords a means for changing the tone of the reproduced sound according to the individual requirements. When rotated in one direction, it goes on increasing the high notes in the reproduced sound, and in the other direction it decreases the high notes and increases the low notes. Let us now try to understand the exact meaning of 'Low Notes' and 'High Notes'. Just as the carrier waves of a transmitting station have different frequencies; the sound waves, when they are converted to electric waves, have also different frequencies. Out of these frequencies there is a certain range of frequency to which alone the human ear will respond. This range is roughly from 200 to 16,000 cycles per second. Compare this with the Carrier Wave Frequencies of the order of millions and see the difference between the two. The male and female voice lies within the frequency range of 200 to 16,000 cycles per second but the average female voice has a frequency higher than the average male voice. And even no two males or females will have same frequency. The Indian musical instrument Tabla or the Western musical instrument Clarionet is a low frequency instrument whereas the Satar or Violin is a high frequency instrument. But all these instruments have frequencies which are in the audible range of frequencies *i. e.* from 200 to 16,000 cycles. The clarity of human voice depends much upon the

sibilants which have a high frequency, and, therefore, when it is desired to hear a speech or a commentary it will be a distinct advantage to keep the tone control in High Note Position. One important point has to be borne in mind that with the tone control in High Note Position, the reproduction of atmospheric disturbances is also aggravated. So the best position would be a compromise between clarity and atmospheric disturbances. The disturbances and atmospherics will be negligible with tone control is in Low Note Position.

For music, some listeners like the high note position and others like the low note position or some choose intermediate position. So far as music is concerned the position of the Tone Control will always be decided on the merits of individual requirements.

VOLUME CONTROL. As the name implies, this control component of the radio set controls the volume. For weak stations it may be required to advance this more and more whereas for very powerful stations it may be required to retard or advance it very little.

WAVE BAND SWITCH. This is a contrivance by which we can convert our two band, three band, four band or five band radio to any single band at a time and as desired. Let the set have any number of wavebands, it is always true that only one of these wave-bands will be used at a time. So to say that the radio, whenever it is being used, is nothing but a single band receiver.

If a radio is a three band set having 12 to 50 meters, 50 to 160 meters and 150 to 500 meters bands, the wave-change switch enables us to operate our receiver on either of these three bands, at will. With the wave-change switch in one particular position we can hear stations on one particular band and our radio set behaves as if it is a single band receiver–though in reality it is a three band set. When the wave-change switch is put on medium-wave position, our set would behave as a single band medium-wave set. The selection of particular band depends on the position of this switch.

TUNING CONDENSER. It is that part of a radio set to which is attached the Station Selector or the Tuner Knob. This condenser controls the selection of different stations on each band. By rotating the knob either clock-wise or anti-clockwise, the tuning condenser, inside the set, is made to rotate; and the rotation of the tuning condenser inside, makes possible the tuning of different stations on any band. It will now be easy to visualise that whether the wave-band-switch is in medium, short or any other wave-band position the tuning condenser is the same for any band.

In some subsequent chapter we will learn the correct methods of operating these "control components" of our radio set.

CHAPTER IV
RELAYS

In the past, so many of the listeners must have heard the Delhi or Bombay station announcing that 'King's speech from B. B. C. will be relayed by Delhi or Bombay station'. The most simple and easily understandable meaning of 'Relay' is the reception of a station on one frequency by another station and transmitting of the received programme by the latter on the same or different frequency or on both.

Suppose for instance that King's speech from London is to be relayed by Delhi station. The simple procedure in this case would be that Delhi station must receive this broadcast from London, and after receiving it, the Delhi station must transmit it on its own frequency. For reception, the Delhi Station must have a very powerful receiving centre having such equipment as will receive the B. B. C. broadcast of King's speech most satisfactorily. The programme, after being received at the Delhi Receiving Centre, is taken over land lines to the Delhi Studio from where these programme signals are again taken over land lines to the Delhi Transmitting Station. From the transmitting station the programme is transmitted on any of the desired wave-lengths. In Fig. 6 a pictorial representation of such a relay is given.

The 'Relay' so far described is relay of one station by another ; but there is yet another type of relay

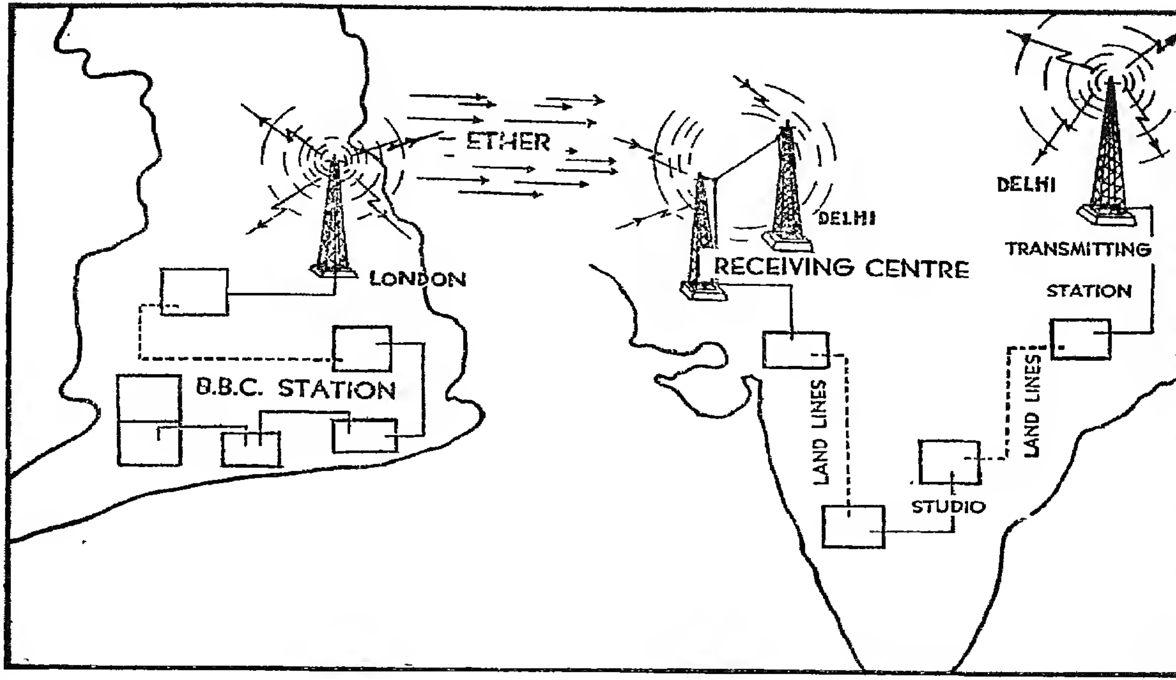

ETHER
LONDON
B.B.C. STATION
DELHI
RECEIVING CENTRE
DELHI
TRANSMITTING
STATION
LAND LINES
LAND LINES
STUDIO

FIG. 6

in which the original programme is not broadcasted by a transmitting station. For example many of us hear the programmes of the anniversary of that great musician artist Abdul Karim Khan relayed by All India Radio. These programmes are not conducted in any of the A. I. R. studios but they take place at Miraj—a place so many miles away from Bombay—the birth-place of this artist. The procedure adopted for relaying these programmes is that the programmes are first amplified at Miraj and taken over land lines (*i. e.* telephone wires) to A. I. R. Central Studio, Bombay, From the studio, after further amplification, the programme moves on to the Bombay Transmitting Station at Worli, from where it is transmitted on the desired wave-length.

If a low power portable transmitter could be available the programmes could be transmitted from Miraj and in that case the land lines from Miraj to Bombay will not be necessary at all.

CHAPTER V

RUNNING COMMENTARY

There is hardly any listener in India who has not heard the running commentaries on the yearly All India Cricket Festival of Pentangulars. Many of the listeners believe that the commentary is transmitted from the stadium itself. But it is not correct.

The Fig. 7 on next page presents a complete picture showing how the transmission of the commentary is effected. The commentator is seen observing the game, while seated in the stadium itself. He is watching the game and talking in the microphone which is placed just before him. As usual, the microphone converts the sound waves into electrical impulses which are amplified by the amplifier. After amplification the signals are carried over land lines *i. e.* telephone wires, to the central studio. Further amplification is carried out in the studio, and again over the land lines, these amplified signals are taken to the transmitting station. Once these signals reach the transmitting station, the transmission is effected on any desired frequency. This is the general procedure adopted everywhere for the broadcasting of such commentaries. When the king addresses his subjects all over the kingdom, it is not that the king has to run to B. B. C. Studio in London. The British King has not to move out of the Buckingham Palace at all. All arrangements are done by the B. B. C., in the palace itself. These arrangements consist of the provision of a microphone, an amplifier and necessary land lines from the palace to the B. B. C. Central Studio, in London.

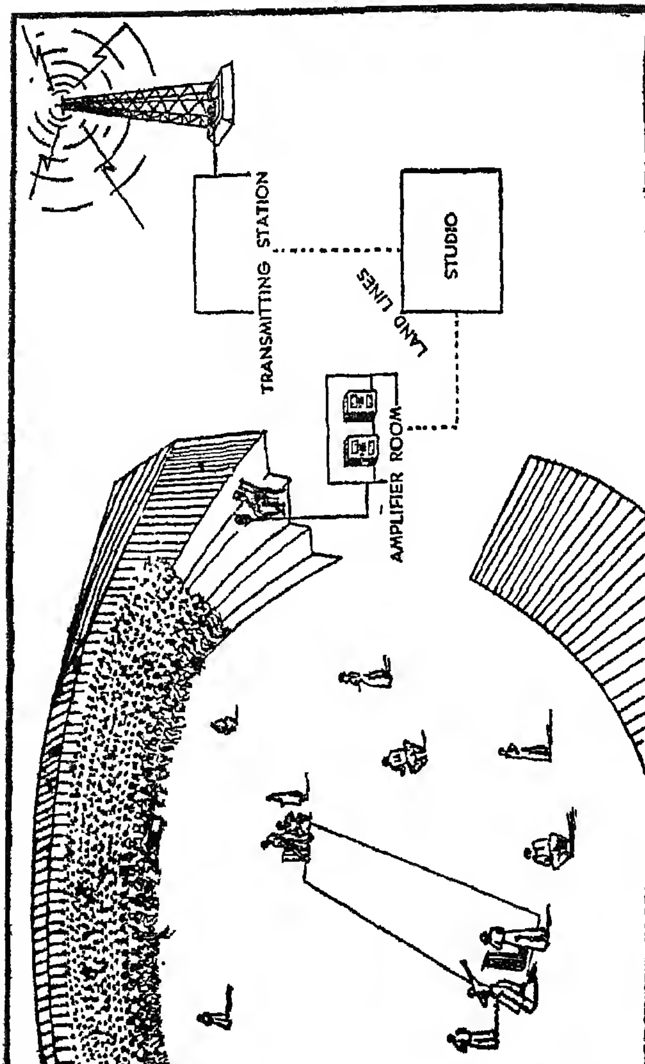


FIG. 7

CHAPTER VI

ALL ABOUT DIALS

In Chapter III, we learnt so much about the different parts of a radio set. Importance of reading the radio dial correctly should not be ignored, because the tuning on short-wave band is so critical that unless the dial is understood thoroughly the listener will either miss many stations or think that his radio set is not very selective. Previously, we have learnt that the position of the tuning condenser and the wave-change switch controls the reception or rather the selection of a particular station.

With the wave-band switch in one position and the tuning condenser in many different positions we can tune many stations on that particular band, but our difficulty of knowing definitely, as to which station is being tuned, still remains unsolved- The acceptable solution to this difficulty would be found in the provision of some visual indicating device in our radio set whereby we could see to what station our radio set is being tuned, when the tuning condenser is moved clockwise or anti-clockwise. Such visual indicating device which is always incorporated in every radio set, is nothing but a combination of a dial and a pointer.

A little imagination will atonce reveal to us that the pointer must somehow be connected to the tuning

condenser in such a way that for the circular motion of the tuning condenser the pointer will either revolve along with it or go from one end to the other end of the dial horizontally or go up and down vertically. As has been said in chapter three, the movement of the tuning condenser is due to the turning of the Station Selector Knob or Tuning Knob, either clock-wise or anti-clockwise. And in view of this explanation, it will now be clear that clock-wise or anti-clockwise motion of the station selector konb brings about either the circular motion or end to end horizontal motion or up and down vertical motion of the dial pointer. Then, we come to this conclusion that for every position of the tuning condenser there is a corresponding definite position of the pointer, and that we should be able to read these different positions of the pointer in terms of the different positions of the tuning condsnser. And since we desire to know—by means of the pointer—which particular station will be tuned for one particular position of the pointer, our concern will be to provide something below the pointer which will have some marks on it that will relate the position of the tuning condenser in terms of frequency or wave-length. This 'something' that we want to provide underneath the pointer or the thing on which our pointer should move, is the DIAL of our radio set.

Having established the necessity of a dial for the radio, let us now find out the reasons why this dial should have some marks on it that will relate the position

of the tuning condenser in terms of frequency or wave-length. In second chapter we learnt that carrier waves of different transmitting stations, carrying different programmes, are constantly striking our aerial. Each station has a different carrier wave from the other station, and each carrier wave has different frequency and corresponding wave-length. Out of the so many carrier waves that are striking our aerial, we have to admit one carrier wave, at a time, in our radio set, to hear the programmes of one particular broadcasting station. And since one carrier wave has a different frequency from the other, our dial should necessarily be calibrated in frequency or corresponding wave-length. Once the dial is calibrated in frequency it will be a simple matter of only reading the dial where the pointer rests, and telling that the radio set is now receiving a programme from a station that uses a carrier wave having a frequency as indicated by the pointer on the dial.

The necessity of having the dial calibrated in terms of frequency or corresponding wave-length having been thoroughly understood, let us now concentrate our attention on the words 'Frequency' and 'Wave-length'.

Let us imagine that a tiny little mosquito enters and taps against the drum of our ear. Our ear will feel the tap. Let the mosquito tap the drum of our ear faster and faster until it taps at the rate of twenty taps in each second. At this rate we will no longer feel the blows but we will hear a musical note. The quicker the mosquito taps the pitch of the note

would get higher and higher until at about sixteen thousand taps a second, we will not hear any note because at this tremendous rate our ear drum will create no vibrations which are so essential in producing the feeling of sound. That the mosquito taps the ear twenty times in a second means the mosquito is repeating its action, of tapping the ear, twenty times in one second. That means the frequency of the taps will be twenty taps in a second.

When we are on a sea beach we see many waves that come along rising and falling. It is the everyday experience of swimmers that higher the waves stronger they are and lower the waves weaker they are. Lower waves merely wash against our legs whereas higher waves are so strong, that they may knock us down in the water as they roll on. So the height of the wave is the "strength of the wave" which is technically called as 'Amplitude'. The distance from crest to crest–AB in Fig. 8 is a complete length of the wave and is therefore called wave-length. And while we are standing in water at one point if we notice that such twenty waves are passing past us in one minute, the frequency of such waves will be twenty per minute. Now if we imagine that the water is moving with a speed or velocity of say 200 feet per minute then the distance AB in Fig. 8 can be found out as follows:—

$$\text{Distance AB} = \frac{\text{Speed of water waves in feet per minute}}{\text{Frequency per minute}}$$

$$= \frac{200}{20} = 10 \text{ feet.}$$

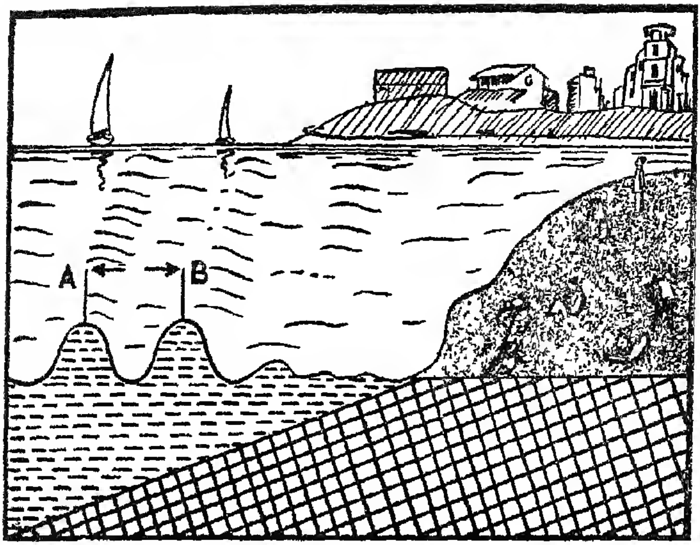


FIG. 8

FIG. 10

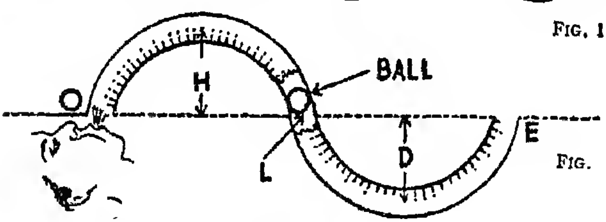


FIG. 9

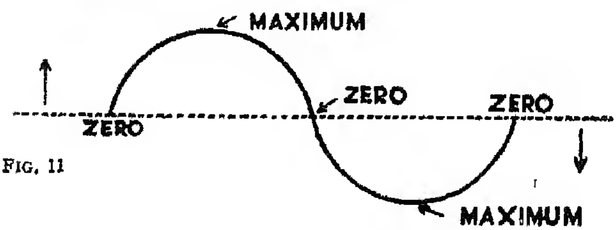


FIG. 11

Let us now study another analogy to understand properly the words frequency and wave-length. Suppose a hose-pipe is bent and given a form as shown in Fig. 9. We now take a ping-pong ball and blow it heavily through the opening in the hose-pipe at O. The ball will roll and roll and come out at the other end E of the hose-pipe. When the ball travels from O to E it completes one cycle of events. It started at O, went up the hose to a maximum height H, then came down to its original level L, and then went down in the opposite direction to a maximum depth D and again came back to original level at E. Thus from O to E the ball performs one cycle of events. Now let us take another piece of hose-pipe which is long enough to allow three such cycles of the ball. In Fig. 10 the ball comes at the point E and from there it repeats the exact path, bend for bend, height for height, and depth for depth as it did while travelling from O to E. After reaching point F it yet travels further and takes an identical path from F to G, as it did while going from O to E or E to F. That means the ball repeats one cycle of events three times; and if the time occupied for these three cycles is one second then the frequency of the ball will be three cycles per second, and the distances O to E, E to F and F to G will each be equal to the wave-length. Let us suppose, that this distance is 12 feet and since we also know that the ball completed 3 cycles in one second, it will be easy to find out at what speed the ball travelled through the hose-pipe.

$$\text{Speed of the ball} = \begin{array}{l}\text{length from O to E}\\ \text{or E to F or F to G}\end{array} \times \begin{array}{l}\text{number of cycles}\\ \text{in one second}\end{array}$$

$$= 12 \times 3$$

$$= 36 \text{ feet per second.}$$

Let us not forget these calculations because we have to use similar calculations for our carrier waves.

After having studied the water and ball analogy, it will be a simple matter to imagine that our carrier waves behave somewhat similar to the water waves or the ball in the hose-pipe. Just like the ball or water waves, these carrier waves start from zero, increase to maximum in one direction, come back to zero, go to maximum in other direction and again come back to zero. And when this is done, they complete one cycle of events and we say that this is one cycle of a carrier or wireless wave (Fig. 11). The great scientists have proved that the speed or velocity of the carrier or wireless waves is 186,000 miles or 300,000,000 meters per second. If a carrier wave is making 1000 cycles of events, of above description, in one second, we can find out the wave-length of this carrier wave by applying the same equation which we resorted to in case of water and the ball.

$$\begin{array}{l}\text{Speed of carrier or}\\ \text{wireless waves in}\\ \text{meters per second}\end{array} = \text{Cycles per second} \times \begin{array}{c}\text{Wave-length}\\ \text{in metres}\end{array}$$

$$300{,}000{,}000 = 1000 \times \text{wave-length}$$

or $$\text{wave-length} = \frac{300{,}000{,}000}{1000} = 300{,}000 \text{ metres}$$

Thus we can now establish one definite relation between speed of waves, wave-length and cycles per second and this would be

$$\text{Speed of waves} = \begin{matrix}\text{No. of cycles}\\ \text{per second}\end{matrix} \times \begin{matrix}\text{Length of}\\ \text{each cycle}\end{matrix}$$

Now let us put the above relation more scientifically. The number of cycles per second is called 'Frequency' in technical language and the length of each cycle is termed as 'Wave-length' and the speed of waves is called the 'Velocity'.

Expressed technically the equation now will read as

(i) Velocity = Frequency × Wave-length.

Since velocity of wireless waves is 300,000,000, metres per second, we can write.

(ii) 300,000,000 = Frequency × Wave-length.

Or

$$\text{(iii)}\quad \begin{matrix}\text{Frequency}\\ \text{(cycles per sec.)}\end{matrix} = \frac{300{,}000{,}000}{\begin{matrix}\text{Wave-length}\\ \text{(metres)}\end{matrix}}$$

Or

$$\text{(iv)}\quad \begin{matrix}\text{Wave-length}\\ \text{(metres)}\end{matrix} = \frac{300{,}000{,}000}{\begin{matrix}\text{Frequency}\\ \text{(cycles per sec.)}\end{matrix}}$$

Knowing any two quantities in the equation (i) or any one quantity in equation (ii), (iii) and (iv) the third can be easily calculated.

If we imagine that there is a certain group of waves which does 300 complete cycles per second then it follows that

$$\text{Wave-length} = \frac{300,000,000}{300} = 1,000,000 \text{ Metres.}$$

The waves that are used as 'carriers' make more than thousands or millions of cycles in one second and, therefore, for easier calculations it will be very advantageous to adopt some other units of frequency. So far, our unit of frequency has been CYCLE. Now for our wireless waves calculations, we will use two convenient units which are known as Kilocycle and Megacycle and abbreviated as Kc/s and Mc/s respectively. The letters Kc and Mc stand for Kilocycles and Megacycles and the letter 's' stands for 'per second'. Just as sixteen annas make one rupee, similarly one thousand cycles make one Kilocycle and 1,000,000 cycles make one Megacycle. Our standard equation (i) for Kilocycles and Megacycles can thus be reduced to the following two forms

$$\text{(v)} \quad \underset{\text{(Metres)}}{\text{Wave-length}} = \frac{300,000}{\text{Frequency in Kc/s}}$$

$$\text{(vi)} \quad \underset{\text{(Metres)}}{\text{Wave-length}} = \frac{300}{\text{Frequency in Mc/s}}$$

We all know that the Bombay Station uses carrier waves of the following frequencies.

1231.00 Kilocycles
9.55 Megacycles
4.88 Megacycles

If we are now asked to find out the different wave-lengths of Bombay Station, our task is very simple. For finding out the wave-length of Bombay corresponding to

the frequency of 1231 Kilocycles, we will have to use equation No. (v) given above.

$$\underset{\text{(Metres)}}{\text{Wave-length}} = \frac{300{,}000}{\text{Frequency Kc/s}}$$

$$= \frac{300{,}000}{1231}$$

$$= 243.6 \text{ Metres}$$

To convert the remaining two frequencies of 9.55 and 4.88 Megacycles into Metres we have to use the equation (vi)

$$\underset{\text{(Metres)}}{\text{Wave-length}} = \frac{300}{\text{Frequency Mc/s}}$$

For 9.55 Mc/s

$$\text{Wave-length} = \frac{300}{9.55} = 31.4 \text{ Metres}$$

For 4.88 Mc/s

$$\text{Wave-length} = \frac{300}{4.88} = 61.48 \text{ Metres.}$$

Same procedure can be adopted for finding out the different corresponding frequencies or wave-lengths of different stations.

On pages 53 to 56 a Frequency-wave-lengths table is given which will be found very useful for finding out the wave-length corresponding to a particular frequency or vice versa. The different frequencies and corresponding wave-lengths used by Indian Broadcasting Stations are given on pages 59–60, whereas the important frequency bands of the world with their wave-length equivalents are given on pages 57–58. This table is of particular use to memorise the wave-length values for the corresponding frequency values or vice versa.

WAVE-LENGTH—FREQUENCY

Wave-length in Metres	Frequency in Kilocycles per second
1	300,000
2	150,000
3	100,000
4	75,000
5	60,000
6	50,000
7	42,855
8	37,500
9	33,333
10	30,000
11	27,273
12	25,000
13	23,077
14	21,429
15	20,000
16	18,750
17	17,647
18	16,666
19	15,789
20	15,000
21	14,285
22	13,636
23	13,043
24	12,500
25	12,000
26	11,538
27	11,111

Wave-length in Metres	Frequency in Kilocycles per second
28	10,714
29	10,345
30	10,000
31	9,677
32	9,375
33	9,091
34	8,823
35	8,571
36	8,333
37	8,108
38	7,895
39	7,692
40	7,500
41	7,317
42	7,143
43	6,977
44	6,818
45	6,667
46	6,522
47	6,383
48	6,250
49	6,122
50	6,000
55	5,454
60	5,000
65	4,615
70	4,286
75	4,000
80	3,750

Wave-length in Metres	Frequency in Kilocycles per second
85	3 529
90	3,333
95	3,158
100	3,000
105	2,857
110	2,727
115	2,609
120	2,500
130	2,308
140	2,143
150	2,000
160	1,875
170	1,765
180	1,667
190	1,579
200	1,500
210	1,429
220	1,364
230	1,304
240	1,250
250	1,200
260	1,154
270	1,111
280	1,071
290	1,034
300	1,000
310	967.7
320	937.5
330	909.1

Wave-length in Metres	Frequency in Kilocycles per second
340	882.3
350	857.1
360	833.3
370	810.8
380	789.5
390	769.2
400	750.0
410	731.7
420	714.3
430	697.7
440	681.8
450	666.7
460	652.2
470	638.3
480	625.0
490	612.2
500	600.0

The dials of all radio sets are calibrated in frequency or wave-length. Some dials have frequency calibrations whereas others carry wave-length calibrations. But with the help of these tables, it is to be hoped, that the difficulty about reading different radio dials will be easily solved.

IMPORTANT BROADCAST BANDS

Megacycles	Metres	
21.6	13.8	13 Metre Band
21.52	13.9	
19.02	15.77	16 Metre Band
18.5	16.23	
17.76	16.89	
17.75	16.9	
17.28	17.36	
15.55	19.20	19 Metre Band
15.36	19.53	
15.31	19.60	
15.28	19.63	
15.20	19.70	
15.13	19.83	
14.60	20.55	
12.00	25.00	25 Metre Band
11.9	25.21	
11.77	25.49	
11.67	25.70	
10.66	28.14	29 Metre Band
10.55	29.16	
9.83	30.52	31 Metre Band
9.62	31.19	
9.6	31.25	
9.43	31.80	

Megacycles	Metres	
7.41	40.46	41 Metre Band
7.30	41.01	
7.25	41.30	
7.17	41.75	
6.10	48.6	49 Metre Band
6.15	48.78	
6.12	48.98	
6.122	49.00	
6.097	49.20	
6.07	49.34	
6.060	49.50	
6.03	49.75	
6.00	50.00	
5.01	59.88	61 Metre Band
4.99	60.12	
4.92	60.98	
4.91	61.10	
4.885	61.42	
4.845	61.92	
4.80	62.50	
3.49	85.8	90 Metre Band
3.365	89.15	
3.30	90.77	

FREQUENCIES AND WAVE-LENGTHS USED BY ALL INDIA RADIO

SHORT WAVE STATIONS

No.	Station	Frequency in Kc/s	Wave-length (Meters)
1	DELHI II	9,590 4,960 7,290 3,494	31.3 60.48 41.15 85.84
2	DELHI III	15,290 9,590 6,085	19.62 31.3 49.3
3	BOMBAY II	9,550 4,880 7,240 3,365	31.4 61.48 41.44 89.15
4	CALCUTTA II	9,530 4,840 7,210 3,304	31.48 61.98 41.61 90.77
5	MADRAS II	11,870 4,920 7,270 3,434 9,570	25.28 60.98 41.27 87.34 31.35

FREQUENCIES AND WAVE-LENGTHS USED BY ALL INDIA RADIO

MEDIUM WAVE STATIONS

No.	Station	Frequency in Kc/s	Wave-length (Meters)
1	DELHI	886	338.6
2	BOMBAY	1,231	244
3	CALCUTTA	810	370
4	MADRAS	1,420	211
5	LAHORE	1,086	276
6	LUCKNOW	1,022	293.5
7	TRICHINOPOLY	758	395.8
8	DACCA	1,167	257.1
9	PESHAWAR	1,500	200

CHAPTER VII

ALL ABOUT TUNING

We all know very well that numerous stations can be received on one particular wave-band in our radio set. On the broadcast or medium band we receive Bombay, Lahore, Dacca, Lucknow, Delhi and so on. Similarly, we receive Calcutta, Bombay, Madras, Delhi etc. on the 60 and 90 metre bands, whereas Germany, England. France, Italy, America, Russia, China, Japan and Java are received on the Foreign Short Wave Band.

The selection of a particular band is done by the wave-change or wave-band switch, and the selection of or 'tuning in' of a particular station, on each band, is done by the Station Selector knob which is fixed outside the cabinet, on the spindle of the variable condenser which is inside. So to say, we actually rotate this variable condenser to tune our radio set to different stations.

In one of the previous chapters we have studied that every transmitting station, whether it is Bombay, Tokyo or London, has to use "Carrier Waves" of some definite frequency which is assigned to each such station by an international body known as International Radio Commission. Whatever be the frequency assigned to a station, it has been noted in previous chapter that it is of a very high nature.

It is an everyday laboratory fact that whenever an electric current—be it D.C. or A.C.—flows through a wire, an electro-magnetic field is created around the wire, just as an air-field is created by an electric fan. The strength of the air-field created by the fan depends on the current in the fan, and similarly, the strength of the electro-magnetic field depends on the strength of the electric current flowing through the wire.

If the wire is wound in a coil form and if Direct Current (D.C.) is made to flow through it, an electro-magnetic field is created which will be steady and not at all changing the direction. But instead of D.C., if we pass Alternating Current (A.C.) through the coil, the direction of the field too goes on changing in accordance with the change of direction of the flow of A C. When the A.C. starts flowing through the coil of wire the electro-magnetic field sets up at the centre of the coil and goes on increasing as the current increases, and, then comes a moment when the circumference of the 'Lines of Force', that constitute the electro-magnetic field around the coil, becomes more than the circumference of the coil itself. And, when this condition is reached the coil which was carrying the Alternating current C has to carry yet another current which is generated due to the action of the electro-magnetic field. This new current I is known as 'Induced Current', and it always flows in opposition to the original current C.

The induced current I is generated in the coil only when A.C. is flowing through it. If D.C. flows, the

induced current I is not generated. Since the induced current I flows in opposite direction to the original current C, it opposes and offers a resistance to the latter.

This simple phenomenon holds good for our carrier waves because these are nothing but A.C. currents having very high frequencies.

Thus we have understood now that when an alternating current flows through a wire—be it straight or in a coiled form—the wire attains a property of generating an induced current which opposes the flow of original A.C. This property of the wire is called the INDUCTANCE of the wire. A coil of wire will have much more inductance than what a straight piece of wire will have. This means that the inductance of a wire does not only depend upon the strength of current flowing, length of wire and thickness of wire but also on the shape of the wire. This inductance of a wire offers a resistance to the flow of the current, and the resistance thus offered is called the INDUCTIVE REACTANCE of the wire or coil.

Inductance and Inductive Reactance are the two new things, that we have learnt now. Besides this 'Inductive Reactance' there is yet another 'Fifth Column', in our radio sets, known as 'Capacitive Reactance'. I call these two types of reactances as 'Fifth Columns' because they work as secretly and dangerously in our radio and play a havoc that can be only compared to the havoc played by the German Fifth Column in Norway.

But on the other hand, if these are set to act against each other our work will be done and we will hear programmes from our radio. First we will try to understand what this Capacitive Reactance is and we will see how these two types of reactances are set against each other.

In chapter III, we have learnt that if two metal plates are separated from each other by an insulator then the combination of the two metal sheets and the insulator is called a 'Condenser.' The condenser has a property of storing electrical charges. When such a condenser is connected to wires carrying alternating current, it offers a resistance to the flow of that current, and, the resistance thus offered by the condenser is called the "CAPACITIVE REACTANCE" of the condenser.

Both these types of reactances are very largely affected by the frequency of the current which they resist. The INDUCTIVE REACTANCE of a coil increases as the frequency is increased whereas the CAPACITIVE REACTANCE increases when the frequency is decreased.

Just as all coils of wire have INDUCTANCE, all condensers have CAPACITANCE. The inductance of a coil is measured in units known as Henry, Millihenry or Microhenry, and, the capacitance of a condenser is measured in Farads, Microfarads or Micro-micro-farads; but the Inductive and Capacitive Reactances are both measured in units known as Ohms and Megohms.

Having understood so much about some very important properties of coils and condensers, let us now

divert our attention to some simple calculations on these reactances, and, remember the following two formulæ :

(i) Inductive Reactance=6.28×Frequency×Inductance

(ii) Capacitive Reactance$=\dfrac{1}{6.28\times\text{Frequency}\times\text{Capacitance}}$

EXAMPLE :—What will be the Inductive Reactance of a coil of 10 Henry Inductance when connected across 230 Volts 50 cycles supply ?

SOLUTION :—

Inductive Reactance

$$=6.28 \times \text{Frequency} \times \text{Inductance}$$
$$=6.28 \times 50 \times 10$$
$$=3140.0 \text{ ohms.}$$

EXAMPLE :—What will be the Capacitive Reactance of a condenser of 1 Farad capacitance when it is connected across a 230 volts 50 cycles supply ?

SOLUTION :—

$$\text{Capacitive Reactance}=\frac{1}{6.28 \times \text{Frequency} \times \text{Capacitance}}$$
$$=\frac{1}{6.28\times50\times1}$$
$$=\frac{1}{314} \text{ ohms.}$$

Now let us imagine that along with a coil and condenser there is a resistance connected across a voltage

supply. The total opposition to the flow of current that will be offered by this combination is called IMPEDANCE of the circuit and it is calculated as follows :

$$\text{Impedance} = \sqrt{(\text{Resistance})^2 + (\text{I. R.} \backsim \text{C. R.})^2}$$

Where I. R. = Inductive Reactance

C. R. = Capacitive Reactance

The sign $\backsim$ indicates that whatever quantity is numerically less should be subtracted from the other. If Capacitive Reactance is more, then Inductive Reactance should be subtracted from it and vice versa.

EXAMPLE :—If a coil of 10 Henry Inductance, a condenser of 1 Farad Capacitance and a resistance of 10 ohms is connected across a voltage supply of 230 volts 50 cycles Frequency, what will be the Impedance of this combination ?

SOLUTION :—

$$\text{Impedance} = \sqrt{(\text{Resistance})^2 + (\text{I. R.} \backsim \text{C. R.})^2}$$

$$= \sqrt{(10)^2 + \left\{\left(6.28\times 50\times 10\right) \backsim \left(\frac{1}{6.28\times 50\times 1}\right)\right\}^2}$$

If we study the Impecande Formulæ and the example solved above, we atonce find out that maximum current can only flow when the Impedance is very minimum. And to make impedance very low—say amounting to zero—the resistance has to be brought down to zero and the Inductive Reactance must be made equal to the

Capacitive Reactance. And when this condition is fulfilled,

$$\begin{aligned}\text{Impedance} &= \sqrt{(0)^2 + (0)^2}\\ &= 0 \text{ ohms.}\end{aligned}$$

This means the circuit offers absolutely no resistance to the flow of current. But this ideal condition can never be brought about in practice because since each conductor (wire carrying the current) will always have some resistance, the resistance value in the above formula cannot be brought down to zero. But practically, it is not impossible to make the Inductive Reactance equal to Capacitive Reactance for a particular frequency at a time, and, in that case

$$\begin{aligned}\text{Impedance} &= \sqrt{(\text{Resistance})^2 + (0)^2}\\ &= \text{Resistance}\end{aligned}$$

That is to say, when the Capacitive Reactance is made equal to the Inductive Reactance, the total opposition to the flow of current is only that offered by the resistance. When such a condition prevails, the technical language calls it as Condition of Resonance *i. e.* the circuit is "In Resonance" at a particular frequency and the effect thus acheived is called 'Resonance Effect.' In simple language we may say that when such a condition exists, the circuit is TUNED to that particular frequency. The effect above described is very important since the principles of tuning our radio are based upon it.

From all the above calculations we clearly see that the circuit can be made to resonate or can be tuned at

some particular frequency. A circuit resonating at say 1000 cycles frequency cannot be made to resonate at 2000 cycles frequency unless and until the impedance value of the circuit is changed; and the impedance value can only be changed either by changing the inductance of the coil or the capacitance of the condenser. By changing either the inductance of the coil or the capacitance of the condenser, we can resonate the circuit (tune the circuit) at any desired frequency.

The theoritical implications of the 'Resonance Effect' have been fully understood and now let us study the method adopted in practice to command maximum advantages of this effect, in tuning our radio sets.

Tuning, as performed in radio reception, consists essentially in setting certain circuits to admit maximum signals of one frequency at a time while checking those of other frequencies for that period.

Many of us know that musical instruments such as Piano, Satar, Dilruba and others go out of tune oftentimes, and, before we could get normal performance from each one of them, the instruments have to be "Tuned." The normal performance means that the particular key of Piano or Satar must give out a note of a particular audible frequency. If it does not, then it is said that the instrument is out of tune. In short the tuning of the musical instruments has something to do with the frequency, and much in the same way the tuning of a radio set has also to do something with the frequency.

Each radio—be it of any make or origin—necessarily has a tuning circuit which is connected to the aerial. And as we learnt above, the coils and condensers are the two very important parts in such tuning circuits. It is the correct manipulation of the inductive reactance of the coils and capacitive reactance of the condensers that brings the circuit to a tuned condition for a particular frequency. There is always a definite relation between the frequency to be received and the capacitance and inductance that is in the circuit of the radio set. This relation is always governed by the following equation :

$$f = \frac{10^6}{6.28\sqrt{LC}}$$

Where L = Inductance of coils in Microhenries

C = Capacitance of condensers in Micro-farads

f = Frequency of the 'Carrier Waves' in cycles per second

Let us suppose that the carrier waves used by a transmitting station have a frequency of 530 kilocycles, and, it is desired to hear this station at a maximum volume in our radio set. Then according to our previous calculations we have to find out such coils and condensers that the reactances of which will cancel out with each other at this frequency, and the effective impedance, of the circuit, for 530 Kilocycles programmes, will be only the resistance in the circuit. By applying the abov

equation we can find out the product of L and C, as follows :

$$530{,}000 = \frac{10^6}{6.28\sqrt{L \times C}}$$

(1 Kilocycle = 1000 Cycles, therefore,
530 KC = 530,000 Cycles)

$$\therefore \sqrt{L \times C} = \frac{1000000}{6.28 \times 530{,}000}$$

$$= \frac{100}{6.28 \times 53}$$

$$\text{or } LC = \left(\frac{100}{6.28 \times 53}\right)^2$$

If we know either L or C we can find out the remaining unknown quantity. In modern radio sets the value of L i. e. Inductance of coils, is always fixed once for all, whereas the value of C i. e. capacitance of condensers' is kept variable. By variable we mean that the value of the capacity of the condenser is not fixed but can be changed within predetermined minimum and maximum limits. If in the above example we suppose that the inductance L in our radio set is say 180 microhenries then we can find out the value of 'C' required to tune the radio to 530 Kilocycles.

$$530{,}000 = \frac{10^6}{6.28\sqrt{180 \times C}}$$

$$\text{or } C = .0005 \text{ microfarads}$$

The simple meaning which we can derive from the above expression is that a condenser of .0005 microfarad

and a coil of 180 microhenries can be so connected in the tuning circuit of our radio as will allow maximum signals of 530 kilocycles to pass in. In other words the station using 530 Kilocycles as carrier, will be received very loudly in the radio receiver which has a coil of 180 microhenry inductance and a condenser of .0005 microfarad capacitance.

The above explanation is very well convincing as far as 530 kilocycle station is concerned but what about many other stations that are using "carrier" of some other frequency than 530 kc/s. The solution to this difficulty lies in keeping the value of C variable by making the condenser variable. Suppose that we now desire to tune our radio set to a transmitting station that is using 540 kilocycles as the "Carrier." By same calculations it can be easily found out that when inductance of the coil remains fixed at 180 microhenries, the capacity of the condenser has to be little less than .0005 microfarad. Thus :—

$$540{,}000 = \frac{1{,}000.000}{6.28\sqrt{180 \times C}}$$

This reduction in the capacity value 'C' of the condenser is possible to attain due to the variable construction of the condenser. The other way round, if we have to receive another station using 500 Kc/s. as carrier, then the capacity value 'C' of the variable condenser will have to be increased. Therefore, the conclusion is that by increasing or decreasing the

capacity value of the condenser, we can receive different stations using different carrier frequencies.

Let us now see how the increasing and decreasing of the capacity value 'C' of the condenser is achieved in a radio set. The means provided in a radio set to achieve this, are very simple. We know that every radio set has a knob marked as "Station Selector" or "Station Finder" or "Tuner" or "Tuning Knob." This knob is fixed or attached to the spindle of the condenser, which projects outside the cabinet. When this knob is rotated the spindle moves along with it and the value of the condenser, inside the radio, also changes. So the knob by which we select different stations is nothing but a means to drive the inner variable condenser and bring it to a desired value. Whether the condenser has come to the desired value or not is known by the position of the pointer on the dial. Reverting to our example above, we will have to turn the knob till the pointer comes to rest on 530 KC. reading on the dial. And it means that we have changed the value of the variable condenser to .0005 microfarads. The dial of our radio set could have been marked in microfarads as well, but since we are more concerned with the frequency we desire to receive and not with the different capacity values of the condenser, the dial is always calibrated either in frequency or wavelength or both.

We have now completely understood the principles on which the tuning is based and the methods employed in practice to achieve it. Our next curiousity is about

the wave-change switch. We have to see why this switch is necessary and whether we can do without it.

A modern all wave radio set has usually three wave bands.

(1) Foreign Short Wave Band (usually from 12 to 40 Metres)

(2) Indian Short Wave Band (usually from 40 150 Metres)

(3) Medium or Broadcast Band (usually from 150 to 550 Metres)

Now suppose for a while that we have no wave-change switch and that we desire to manage somehow and get reception on all the three bands without manipulating any switch. If we study the following equation once again, we atonce find that since

$$f=\frac{10^6}{6.28\sqrt{LC}}$$

the product LC will have to be lowest for the 1st band, highest for the 3rd band and some intermediate value for the 2nd band. All these values of LC have to change from minimum to the maximum value. This is not found to be practical with one coil and condenser because of the size and shape of the coil and a very big dial that may have to be used. The only practical solution has been to use different coils for each band, keeping the variable condenser (Tuning Condenser) common or same for all the three bands. That means

for a three band set of above description, we will have three sets of coils whereas a two-band set will have two sets of coils.

Having established the necessity of different coils, we will have to provide some means to select the particular set of coils for a particular wave-band. This is done by the " Wave-change Switch. " By operating this, the required set of coils is connected in the circuit and the remaining sest of coils are automatically put out of use for that period. When the switch is placed on Foreign Short Wave position, only the Foreign Short Wave coils are being used and the coils of the remaining two bands are automatically kept disconnected. When the switch is moved to Indian short wave position, the Foreign Short Wave coils are disconnected, and so on.

This is how the wave-band switching is achieved in modern radio sets. The variable or the tuning condenser remains the same for all bands but the inductances or coils are altogether different for each band.

CHAPTER VIII

COST OF ELECTRICAL CONSUMPTION

Before a radio set is purchased, it becomes useful to know the approximate charges one will have to pay every month for the electrical energy consumed by the radio every month. It will be an advantage to know, beforehand, by how much a particular radio set is likely to increase one's electrical bill.

It is the common experience of every one of us that when we go out in the bazar to buy an electric bulb, the first question asked by the shopkeeper is 'How many watts?' Most of us get baffled at this question because the significance of the word 'watts' is unknown to us. Those of us who know that a higher wattage bulb gives brighter light and the lower wattage bulb gives dimmer light, would further like to know how much more a higher wattage electric bulb is going to increase the electric bill or a lower wattage bulb decrease it. Similarly, when a radio set is to be purchased, the next important consideration after the initial cost of the receiver is its 'Running Cost' which can be classified under two heads viz. Maintenance and Electrical Consumption.

When we talk of electrical consumption, either of the electric bulb or the radio, we have always to do something with WATTS because in simple terms electrical

consumption is nothing but electrical energy consumed which is expressed in WATTS A watt represents the rate at which the circuit is working. Costing of the electric current is based on the total electrial energy consumed which in turn depends upon the time. The accepted standard unit for electrical energy measurement is called Board of Trade Unit (B. O. T. Unit) which is equivalent to an output of 1 Kilowatt (1000 Watts) over one hour. That is to say, when one Kilowatt energy is taken continuously for one hour, the electrical consumption would be one B. O. T. Unit. In commercial electric bills which we receive in the month end, these B. O. T. units are merely termed as ' Units '.

For example, let us suppose that one electric bulb of 50 Watts is used daily in kitchen for four hours from 6 to 10 P. M. This means that the bulb consumes $50 \times 4 = 200$ Watt-Hours of electrical energy in four hours, and, $200 \times 30 = 6000$ Watt-Hours every month. Now these 6000 Watt-Hours when divided by 1000 will give us 6 Kilo-watt-Hours or 6 Units. If the Electric Supply Co.'s rate is three annas per unit, the monthly charge for the electrical consumption of this bulb will be $6 \times 3 = 18$ annas or one rupee and two annas.

Now let us consider an electrical installation in which the following bulbs of different wattage are being used, in different rooms, daily for some average time specified against each.

Place	Wattage of Bulbs	Daily average use in Hours	Days in Month	Monthly consumption in Watt-Hours	Monthly consumption in B. O. T. Units *i.e.* Kilo-Watt-Hours or Units
Kitchen	50	5	30	7,500	7.5
Drawing Room	60	3	30	5,400	5.4
Bed Room	40	2	30	2,400	2.4
Staircase	40	3	30	3,600	3.6
Study Room	20	1	30	600	.6
				Total Units	19.5

If the rate is annas three per unit, the monthly electrical bill for the above installation will be $19.5 \times 3 =$ 58.5 annas or Rs. 3–10–6.

We have now fully understood the significance of the word 'Watts' and the simple calculations by which we can calculate, with correctness, the charges we have to pay for the electrical consumption

Just as electric bulbs are rated in watts, similarly the radio sets are also rated, for their electrical consumption, in Watts. And, when the electrical consumption of both the lamp and radio is specified in Watts, the method of calculation adopted in case of electric bulb can be correctly applied in the case of radio sets also.

For example let us take the case of Merconi Radio Receiver, Model 538. The manufacturer's specification for this model reads as follows :—

Voltage Range	195 to 255 A. C.
Speech Output	5 Watts
Number of Valves ...	8
Power Consumption ...	127 Watts

A glance at the above specification shows us that there are two different items where we find the word "Watts," one is in connection with Speech Output and the other is in connection with Power Consumption. Out of these two, we are concerned only with the Power Consumption Watts. Speech Output Watts are quite different than the Power Consumption Watts and one should not be mistaken for the other.

So our calculations for the electrical consumption of this Marconi Radio Set will have to be based on 127 Watts. Calculating the same way as we did above in case of the lamps, the model 538 Marconi, if used daily for three hours, will consume in one month

$$\frac{127 \times 3 \times 30}{1000} = 11.4 \text{ Units}$$

And the monthly charges, for the electrical consumption for this model, at the rate of three annas a unit, will be $11.4 \times 3 = 34.2$ annas or Rs. 2-2-0.

This is how we can make a reasonable accurate estimate of our radio consumption provided we do not forget to switch off the radio before we go to sleep.

Generally, power consumption of different radio sets is somewhere between 30 and 170 Watts. The rates per unit commonly found in the various cities of India are

(*a*) Three annas per unit
(*b*) Four " " "
(*c*) Six " " "
(*d*) Eight " " "

The tabulated data on the next four pages gives the hourly consumption charges of radio sets of different Wattage in fraction of an anna, calculated on the basis of four different rates that are given above.

By using this table, we can readily find out how much a particular radio may cost us per hour or every day or every month or even a few hours. For example,

we find from the table that the charge for electrical consumption of a radio of 50 Watts, if used for one hour, is $\frac{2}{5}$th of an anna, if the rate is 8 annas per unit. If this radio set is used for two hours the charge will be $\frac{2}{5} \times 2 = \frac{4}{5}$th of an anna. If it is used for five hours the charge will be

$$\frac{2}{5} \times 5 = 2 \text{ Annas}$$

If we use this radio on an average for 5 hours daily, we will have used it for 150 hours in a complete month of 30 days; and the monthly charge will then be

$$\frac{2}{5} \times 150 = 60 \text{ Annas or Rs. } 3\text{–}12\text{–}0$$

This is how these simple calculations are made from the above tabulated data, and charges for the consumption of any radio can be pre-calculated before actually buying a set. It is certainly a distinct advantage to have some precise information about the electrical consumption of the radio before we actually buy it. And if after full consideration of this factor, the radio is bought, we will not have any uneasy hours to pass when the electric company presents its monthly bill to us.

Rated Power Consumption in WATTS	HOURLY CHARGES IN FRACTIONS OF AN ANNA			
	At 3 annas a Unit.	At 4 annas a Unit.	At 6 annas a Unit.	At 8 annas a Unit.
30	$\frac{9}{100}$	$\frac{3}{25}$	$\frac{9}{50}$	$\frac{6}{25}$
35	$\frac{21}{200}$	$\frac{7}{50}$	$\frac{21}{100}$	$\frac{7}{25}$
40	$\frac{3}{25}$	$\frac{4}{25}$	$\frac{6}{25}$	$\frac{8}{25}$
45	$\frac{27}{200}$	$\frac{9}{50}$	$\frac{27}{100}$	$\frac{9}{25}$
50	$\frac{3}{20}$	$\frac{1}{5}$	$\frac{3}{10}$	$\frac{2}{5}$
55	$\frac{33}{200}$	$\frac{11}{50}$	$\frac{33}{100}$	$\frac{11}{25}$
60	$\frac{9}{50}$	$\frac{6}{25}$	$\frac{9}{25}$	$\frac{12}{25}$
65	$\frac{39}{200}$	$\frac{13}{50}$	$\frac{39}{100}$	$\frac{13}{25}$
70	$\frac{21}{100}$	$\frac{7}{25}$	$\frac{21}{50}$	$\frac{14}{25}$

6

Rated Power Consumption in WATTS	Hourly Charges in Fractions of an Anna			
	At 3 annas a Unit.	At 4 annas a Unit.	At 6 annas a Unit.	At 8 annas a Unit.
75	$\frac{9}{40}$	$\frac{3}{10}$	$\frac{9}{20}$	$\frac{3}{5}$
80	$\frac{6}{25}$	$\frac{8}{25}$	$\frac{12}{25}$	$\frac{16}{25}$
85	$\frac{51}{200}$	$\frac{17}{50}$	$\frac{51}{100}$	$\frac{17}{25}$
90	$\frac{27}{100}$	$\frac{9}{25}$	$\frac{27}{50}$	$\frac{18}{25}$
95	$\frac{57}{200}$	$\frac{19}{50}$	$\frac{57}{100}$	$\frac{19}{25}$
100	$\frac{3}{10}$	$\frac{2}{5}$	$\frac{3}{5}$	$\frac{4}{5}$
105	$\frac{63}{200}$	$\frac{21}{50}$	$\frac{63}{100}$	$\frac{21}{25}$
110	$\frac{33}{100}$	$\frac{11}{25}$	$\frac{33}{50}$	$\frac{22}{25}$
115	$\frac{69}{200}$	$\frac{23}{50}$	$\frac{69}{100}$	$\frac{23}{25}$

Rated Power Consumption in WATTS	HOURLY CHARGES IN FRACTIONS OF AN ANNA			
	At 3 annas a Unit.	At 4 annas a Unit.	At 6 annas a Unit.	At 8 annas a Unit.
120	$\frac{9}{25}$	$\frac{12}{25}$	$\frac{18}{25}$	$\frac{24}{25}$
125	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1
130	$\frac{39}{100}$	$\frac{13}{25}$	$\frac{39}{50}$	$\frac{26}{25}$
135	$\frac{81}{200}$	$\frac{27}{50}$	$\frac{81}{100}$	$\frac{27}{25}$
140	$\frac{21}{50}$	$\frac{14}{25}$	$\frac{21}{25}$	$\frac{28}{25}$
145	$\frac{87}{200}$	$\frac{29}{50}$	$\frac{87}{100}$	$\frac{29}{25}$
150	$\frac{9}{20}$	$\frac{3}{5}$	$\frac{9}{10}$	$\frac{6}{5}$
155	$\frac{93}{200}$	$\frac{31}{50}$	$\frac{93}{100}$	$\frac{31}{25}$
160	$\frac{12}{25}$	$\frac{16}{25}$	$\frac{24}{25}$	$\frac{32}{25}$

Rated Power Consumption in WATTS	HOURLY CHARGES IN FRACTIONS OF AN ANNA			
	At 3 annas a Unit.	At 4 annas a Unit.	At 6 annas a Unit.	At 8 annas a Unit.
165	$\frac{99}{200}$	$\frac{33}{50}$	$\frac{99}{100}$	$\frac{33}{25}$
170	$\frac{51}{100}$	$\frac{17}{25}$	$\frac{51}{50}$	$\frac{34}{25}$
175	$\frac{21}{40}$	$\frac{7}{10}$	$\frac{21}{20}$	$\frac{7}{5}$

Note :—In some towns there is a separate low rate of two annas or one and a half anna per unit for heating appliances etc. For calculations on these rates the figures in columns three and two have to be halved.

CHAPTER IX

FACTS ABOUT SHORT WAVES

Several years ago there had been only two groups of waves generally used for broadcasting. One was called 'Long Waves' and the other 'Short Waves'. This nomenclature was applied in the past on the following basis :

Long Waves—from 1000 to 2000 Metres
Short Waves—from 200 to 500 Metres

But, when shorter wave-lengths came into use for broadcasting, the old nomenclature of above description had to be changed. At present the following classification is accepted as standard practice :

1 LONG WAVES

150—300 Kilocycles per sec. (2,000—1000 Metres)

2 MEDIUM WAVES

550—1,500 Kilocycles per sec. (545—200 Metres)

3 SHORT WAVES

6–30 Megacycles per sec. (50—10 Metres)

4 ULTRA—SHORT WAVES

Above 30 Megacycles (Below 10 Metres)

It is about the third group that we are going to learn some very interesting facts.

The very predominant and striking fact about short waves is that its extraordinary features and

advantages were not exploited by the scientists but it has been the work of active amateurs who, having suspected the phenomenal possibilities of disturbing the wave-length spectrum below 200 metres, devoted all their spare time and fortune after the marvellous idea of establishing wireless communication over any distance. It was a time when the entire wave-length spectrum below 200 metres was a vast silence and science was still searching the domain of a long and medium wave transmissions, when these active amateurs came to the fore and successfully pioneered the short-wave transmission. 200 meters was then considered as short-wave, and all amateurs had with them apparatus for 200 meter work only. But this was found to be too inadequate for long distance transmissions. Three ideas fired the imagination of these amateurs instantaneously; out of which the idea of increasing the power had to be put aside because they had already reached the legal maximum of one kilowatt, and, their second idea of developing better receivers had been alreaady materialised by Armstrong who invented the Super-hetrodyne Receiver. The third idea of trying some wave-length other than 200 metres, had tremendous potentialities. In spite of the dictum of the engineering world of those days (1921), the amateurs decided to try wave-lengths below 200 Metres.

The American Radio Relay League (A. R. R. L.) took up this matter very seriously and carried out test transmissions on 90 to 130 metres wave-length with

great success. The results had been very gratifying and encouraging. The most sensational observations revealed that the results were better on lower wave-lengths. These observations of the A. R. R. L. diffused like a wild fire through out U. S. A., and late in the year 1923 two way communication across the Atlantic was established on a wave-length of 110 Metres.

These amateurs had been very active and all the same very ambitious. Even with 100 Metres, discontentment still ruled, with the result that the wave-length was brought down and down till it came to 20 metres and enabled the amateurs to have a two way communication from east coast of U. S. A. to the west coast direct and at noon. Thus the amateurs were the pioneers to explore the realm of short-waves and it was the result of their fortune, their time, their energy and their hobby that led the short-wave commercial enterprises afterwards.

It is due to short-waves alone that long distance transmission and subsequent reception is possible now-a-days. And, when these waves came into use the old style of calling 200 to 500 metres as short waves had to be given up and a new classification of wave-bands came into force.

The radiation of waves from a transmitter is propagated in a straight line in much the same way as a ray of light would travel from one place to the other. And if the curvature of the earth is taken into consideration it becomes abunduntly clear that a wave

propagating from one place will not reach other place under normal circumstances. But the very fact that we hear long distance transmissions from England and Germany almost daily, induces us to believe that there must be *something*—somewhere that is helping the propagation of radio waves round the curvature of the earth. This 'something' was found out by two famous scientists named Kennelly and Heaviside. These scientists proved the existance of a layer of ionized gases at a height of 50 to 200 kilometres (15 miles) above the earth's surface. This layer of ionized gases, known as Kennelly—Heaviside layer, acts on the radio waves much in the same way as a mirror would act on light rays. So to say the layer reflects the waves back to earth. There is no doubt that certain amount of energy is lost in this reflection but nevertheless the waves do continue their downward journey to earth. The radiation from a transmitter is propagated in two ways. The one is due to the 'sky wave' or 'space wave' which strikes the Kenny-Heaviside layer and the other is due to the 'ground wave' which propagates along the earths surface.

In Figs. 1,2 and 3 it is shown how a 'sky wave' is reflected back to earth's surface by the Kennelly-Heaviside layer.

The 'ground wave' dies away after some distance due to ionisation of the air. *During day time the sun's rays ionise the air to an increasing extent, and, this is one reason why medium wave stations cannot be received*

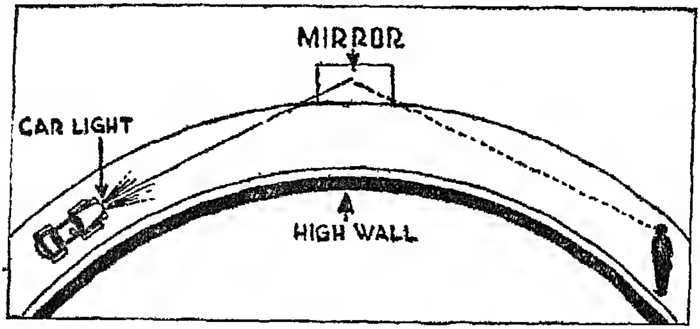


FIG. 1

Due to the curvature of the earth, the car is not in the sight of the man but on account of the reflection due to Mirror the man easily sees the car light.

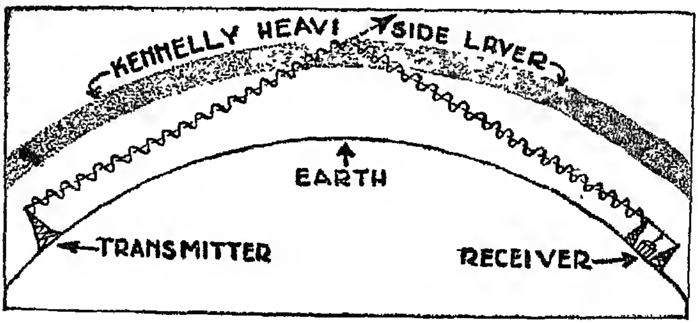


FIG. 2

The Kennelly-Heaviside layer acts as a Mirror and reflects the short waves back to earth enabling to receive the transmitted signals around the curvature of the earth.

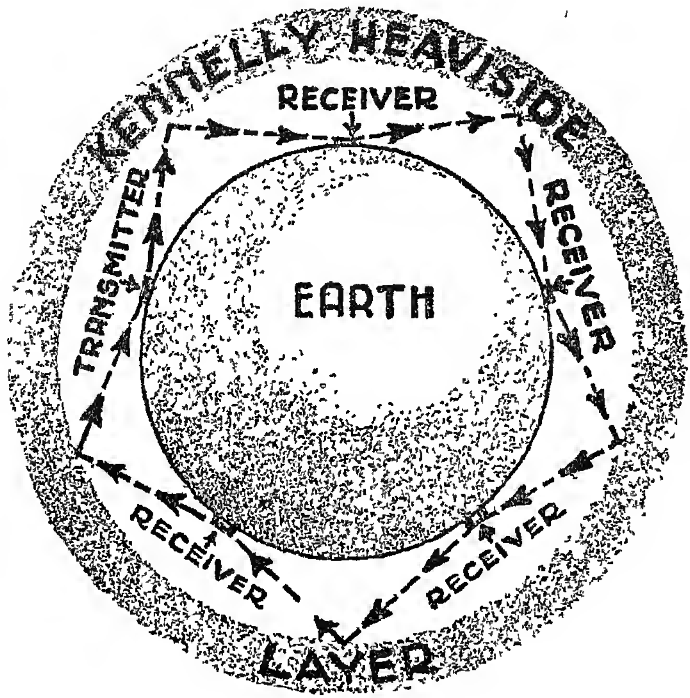


FIG. 3

This pictorial diagram shows how short waves are bent right round the earth enabling communication to be established between any two distant points on the earth

over long distances, in day time. During the period after sunset and before sunrise, the absence of sun causes the ionisation of the air near the ground level to disappear and therefore long distance reception on medium wave band is possible only after dusk. Our difficulty as regards medium wave stations is that if 'ground wave' is unable to carry the programmes over long distance, in daytime, due to ionisation of air why do we not get reception on this band in day time through the 'sky wave' or space wave? To explain this we will have to go back to our mirror—I mean the Kennelly Heaviside layer—and see how it acts on the 'space wave' of the medium and long wave bands. During day time, due to effect of the sun the Kennelly-Heaviside layer does not reflect the 'sky wave' of these two bands properly whereas it does so very successfully after sunset.

The case with short waves is quite different. The main part of a short wave transmitter's energy is radiated straight upwards at an angle depending upon the relation between wave-length and the aerial-system used. Besides, these short waves unlike the medium and long waves, have the property of being propagated almost without loss of energy, in the upper atmosphere. That means there is no loss during their passage through the intervening space to the Kennelly-Heaviside layer. The reflection losses are very negligible in case of short waves whereas they are tremendous in case of medium and long waves. The Kennelly-Heaviside layer acts

efficiently on short waves whether it is daytime or night. Therefore, it is possible to receive short wave station at any time but the only defect sometimes noticed is that of violent fading which of course can be avoided by adopting a slightly different wave-length by day and by night. For example we receive London better on 16 and 19 metre bands in the afternoons and evenings, and on 25 and 31 metre bands in the night and early morning.

Another great advantage of short waves is that reflectors can be arranged at the transmitting station to concentrate the radiation in one direction only. When we talk of B. B. C's. Empire Service, the simple meaning conveyed to us is that reflectors have been arranged at the B. B. C. Transmitting Aerial, focussing all radiation of the programme towards the direction of the empire.

Factors such as day and night, summer or winter have a great influence on the condition of the Kennelly–Heaviside layer and its height from the earth's surface. Waves between 13 and 19 metres give good reception at great distances provided daylight prevails in the space between the transmitter and our set. And that is the reason why London on 16 and 19 metres is received very powerfully in the evenings. On 19 metres good reception can be obtained during daylight at a minimum distance of 2500 Kilometres (155 miles approx.). Good reception on 25 metres generally demands a minimum distance of 1600 Kilometres.

Whereas day and night have comparatively less influence on 31 metre band and good reception is possible during all the 24 hours, if the distance is more than 1300 Kilometres (100 Miles approx). When darkness reigns in the space between the transmitter and radio set, best reception is obtainable if the distance is more than 500 Kilometres (31 Miles approx.).

We have now learnt good many facts about short waves and we find ourselves in a position to formulate following rules that may guide us while tuning our radio on short wave band.

(1) We should not expect to find a station on each graduation mark of the dial. We should search for station in the broadcast bands, and, use a wave-length table. For example, it will be futile to move the pointer around 22 metres to get a station.

(2) The tuning knob should be turned very slowly and carefully. If we go very fast from one end of the dial to the other, we may not get any station.

(3) we should always remember that reception on short waves is largely influenced by the time of the day. Less the day light higher the wave-length and more the daylight lower the wave-length.

(4) We must make sure that the desired station is on the air and that the hour is

favourable for reception on that particular band.

(5) It should be always realised that conditions change continually. If reception is bad one day, it may not be so the next day or it may surpass all expectations on the third day.

(6) While 'tuning in' we may pass over a very powerful station if the fading period of that station and the pointer-crossing period coincide. It is better to try two three times at intervals and we may get the station in the next attempt.

(7) Good outdoor aerial is absolutely essential for best results.

(8) We should make an exact note of good reception of a particular station stating wave-length, name of station, exact date, time and day. This may be useful for future reference.

CHAPTER X

PROTECT THE RADIO

One of the major problems that haunts the minds of the listeners these days, is the life of a radio set. However queasy the customer may be about selecting a most durable Radio Set, there is no knowing about the failure of that too. Radio set like other material things, is not immune to perishability. It is bound to perish some day or the other and sooner or later. Radio Set is perhaps the only apparatus that is built out of such parts and components that are very largely affected by climate and humidity. The violent humidic fluctuations and the intensified extremeties of climatic changes found common in this country, act very adversely on these parts and components. This is perhaps the main cause of the early deterioration of some of the components of a radio set. Since it is nature's infliction, we have got to face it if we have to use a radio.

Buying of cheaper variety of sets should be positively discouraged. It is not at all paying in the long run. When we buy on price we can never be sure. It is unwise to pay too much but it is worse to pay too little. When we pay too much we loose a little money—that is all. But when we pay too little we sometimes loose everything, because the thing we bought is incapable of doing the thing it was expected to do. The common law of business balance prohibits paying a little

and getting a lot. It cannot be done. If we deal with the lowest bidder it is well to add something for the risk we run, and if we do that we will have enough to buy quality. Therefore, we should not hesitate to pay more and buy quality. The initial cost of a quality radio is more than the cost of a radio of inferior quality but the latter demands heavy repairs at quick intervals making its cost equal to that of the quality radio or sometimes more. We have to choose between paying more to-day or tomorrow, and, it is worthwhile to pay it to-day and just this moment.

A belief has come to stay in the public that English, German, Swiss or any other continental makes of radio sets are more durable than the sets of American Manufacture. Unfortunately there is certain truth in this general belief and the paramount cause of this deep rooted belief can be found in the large influx of cheap Amerscan Radio Sets in the Indian market. But this belief cannot be generally applied to all American Radios, because there are American Radios that can stand class to class with any other continental radio. It is for us to select the best of the whole lot.

Whether the radio is a high priced one or otherwise, it is always open to faulty operation and misuse at the listener's hands. If proper care is exercised in operating, the high priced set, which was to go out of order after three years, may not do so for four years or a cheap receiver that was to go erratic after a few weeks may give us splendid service for some months more to

come. There are many operations, that we perform on our radios, which apparently look very insignificant but have disastrous effect on the life of a radio. If precautions are taken, the radio is bound to survive for a much longer time. Therefore, the listeners should read the following cases very carefully and try to act accordingly.

CASE 1

Many of the listeners are in the habit of switching 'off' the radio while changing or operating the Wave-change Switch. When the wave-change switch is operated, with the receiver on, sometimes we get loud clicks and that frightens us. When the set is switched off and wave-change switch operated, the clicks disappear and the listener thinks that there are no heavy jolts on the parts of the radio and all that. But in reality, the listener is running more risk by adhering to this practice. Every time the receiver is switched on, some of the parts in the radio set have to momentarily stand a much higher voltage than the usual rated voltage. And unfortunately this is a phenomenon from which even the best designed or costly quality sets too are not free. Since this phenomenon of higher voltage getting momentarily impressed upon components designed for lower voltage, connot be avoided in the design or manufacture of the radio set, it will be most economical and wise to cut down the switching 'on and off" to a minimum. This does not, however, mean that we should not switch on the radio frequently. We can

switch it on or off any number of times during a day but we should take precautions to see that the radio is not unnecessarily switched off and switched on. For example, switching off the radio for purposes of operating the wave-change switch, can be taken as unnecessary switching. As a matter of fact it will not only be unnecessary but the dangers get immensely multiplied. If we are using the radio for say three times a day we are switching it on only three times but if we happen to be in the habit of switching off while changing the wave band, we will have to take recourse to many more switchings. Suppose that while hearing morning programmes we want to hear Delhi on 31 metres, Bombay on 41 metres and 244 metres. In this case we will switch off the radio and again switch it on for atleast three times. And if the very procedure is repeated in the afternoon, evening and night, the total unnecessary switchings will be about twelve. This means that the danger of some part getting damaged, due to the high momentary voltage, is twelve times more than what normaly it would be. Then why operate the wave-hange switch like this ? Therefore follow the practice of operating the wave-change switch, keeping the radio 'on' all the time, and the volume control on minimum setting. Never think for a moment that by doing so the radio will be damaged. On the contrary remember always that the other practice is more hazardous.

CASE 2

When we have a local station or when we know

that a particular station comes through bombarding, we should make a note of this particular station. The loudspeaker of the set would sometimes stand in danger if this fact is neglected. Let us see how it is. When we have tuned our radio to some distant and very weak station, we have to advance the volume control of our set to a maximum position. Now suddenly if we try to tune in the local or the powerful station, the loudspeaker will always get heavily blasted and sometimes badly damaged. Just try to understand what has happened. On the station to which the radio was previously tuned, the volume control setting was maximum. And when we tried to tune in the local or the powerful station, the volume control setting should have been very minimum but having forgotten to reset the volume control to minimum position, the loudspeaker got heavily blasted due to the local station or the strong station. Therefore, as a safeguard against the damage to the loudspeaker we have to remember the position where the local station or any other strong station is likely to be received. Once we have this information, we should not forget to bring the volume control setting to a minimum before any attempts are made to tune the powerful stations. Apart from the likelihood of the loudspeaker getting damaged, there is every possibility of shortening the life of the volume control as well. When the local station blasts the loudspeaker, the volume control is suddenly brought to a minimum setting in a very rough and rude manner.

Volume controls should always be operated very gently, slowly and gradually.

CASE 3

Dangers of our aerial getting accidentally grounded can be avoided by entrusting the job of aerial installation to the experts in the line. It will definitely be a penny-wise and pound foolish policy to economise on this small item of expenditure, by carrying out the installation ourselves. The aerial installation involves but a very low cost which when compared with the price paid for radio set, is very negilgible. Bear in mind always that an aerial installation done by experts will be far better, more durable and neater than an installation carried out as a hobby or as a means of economy. The danger of the aerial getting accidentally grounded is more in an installation done by ourselves than in the installation carried out by experts who have years of experience of carrying out such jobs.

A grounded or partially grounded aerial is always a standing menace to any radio set, and, the menace is more actute in case of a universal radio set which works on A.C, as well as D.C. It is, therefore, always advisable to get the job done by the experts in the line. When entrusting such jobs to the experts we should of course decline paying any fabulous price for such an installation but at the same time we should never grudge paying the reasonable amount. If we insist on them to make it lower than the reasonable amount there is always a risk of getting inferior material because no radio dealer is going to sacrifice anything for us out of his own pockets.

CASE 4

There have been many cases where the radio set has been kept on throughout the night. It is not done purposely but the forgetfulness on the part of the listener has to account for it. After hearing the programme late at night, the listner goes to sleep forgetting in the meanwhile to switch off the radio. The listener puts the radio on after his evening meals, say at 7 P.M., and it becomes a non-stop operation till 7 A.M. the next morning. Twelve hours at a stretch is too long a period for a radio to work continuously. In many cases either the mains transformer will get damaged or some valves or condensers. Sometimes there may not be any immediate harm but such a practice will shorten the life of a radio to a considerable extent. Those of us who cannot manage not to forget the "switching off" of the radio before going to bed, are advised to use 'Time Switches' for the radio sets. These switches are adjusted for a predetermined time and they switch off the power automatically at that exact hour. For instance if the time switch is set at 12 midnight, and if we forget to switch off the radio at 10 P. M., the radio will be automatically switched off by this time switch at 12 midnight.

CASE 5

Some of us are in the habit of postponement of minor repair to the radio till it becomes absolutely inoperative. This practice should immediately be discouraged. If the receiver performance is not normal

it is a sure indication of something being amiss somewhere in the radio. And if the set is worked in this condition there is every possibility that the matter may get worst to such an extent that the repair charges may multiply beyond measure. 'A stitch in time saves nine' should be the policy to be adopted in such cases. As soon as it is doubted that the receiver performance is not normal, get the radio engineer to examine it and ask him to do the needful atonce.

CASE 6

The 'dust' problem is not so very acute in cities like Bombay but it is aggresively so in other parts and towns of India. It has been very difficult to find out a solution for this. The back of the radio under no circumstances can be entirely closed by cloth or a wooden plank, as the perforations are extremely essential for the dissipation of the internal heat. The only plausible solution is that at least every three months (every month is still better) the radio set has got to be taken out of the cabinet and stripped off all dust. We can do it ourselves if a little care is exercised. It may be difficult for the first time but once we get used to it, this will be no big a task. However, some radios are too difficult to be taken out from the cabinets and it is advised that in such cases a contract should be entered into with the local dealers on monthly basis whereby our radio should be cleaned every two or three months by the dealer for which he should get a nominal charge. At first consideration this practice may seem to involve

unnecessary expenses but in the long run it will be found that a negligible amount, spent on this item, will have saved a lot in future. To let the dust remain like that is to definitely shorten the life of a radio. We cannot wish a long life to the radio when the body of it is full of dust. Over and above this, always remember that sometimes the dust causes the erratic behaviour of the radio.

CASE 7

Rats and cockroaches are yet a great nuisance to the radio set. It has been found out that sometimes rats and cockroaches do worst sort of damage to a radio. The author has come across hundreds of cases where the loudspeaker cones had provided a feast to the rats, and, coils and condensers proved a lavish dish to the cockroaches. There are many powders and medicines available in the market that keep the rats away. Such medicines should be tried. As for cockroaches, the problem appears to be more severe. Some cockroaches fall a victim to one medicine or powder whereas the same powder has no effect on some other cockroaches. Therefore, we have to try different powders and medicines and then find out which powder serves the purpose for the type of cockroaches we have in the house.

CASE 8

In some Indian towns and cities there are two types of electric currents available, In some localities it will be A. C. whereas in others it will be D. C. A radio

set manufactured to work on A.C. current only, will never work on D.C., unless some contrivances such as 'Rotary Converters' are used. If an A.C. Radio is plugged in direct in the D.C. Mains, the transformer inside the radio will burn out immediately and some of the condensers may get damaged. Similarly a radio set specifically designed for operation on D.C. Mains will burn out immediately if plugged in A.C. Mains.

Therefore, when purchasing a radio, due consideration has to be given to this very important point. We should always have the knowledge of the type of current we have in house, because the first thing the radio salesman will ask is whether we desire to have an A.C. set or D C. set or AC/DC set.

When we have to shift from one house, in one locality, to another house in some other locality, or from one town to other, we have to ascertain first whether the electric supply is A C. or D.C. If the radio is switched on without ascertaining this, regrettable disasters may happen. In many big cities like Bombay, Calcutta, Gwalior and others, there are both types of currents available. Some areas of the town are fed by A.C. and some by D.C. The author has come across many cases of 'radio catastrophes' where the above point was unknowingly disregarded.

There are many simple non-technical methods that can be relied upon to find out whether the current is D.C. or A.C. Some of these useful methods are described below.

(*a*) We may just find out if any of the neighbours in the new premises has a radio set. If some one has it, we should request him to let us have a look at the back of the receiver. In almost all types of receivers we will find letters such as "230 Volts A. C" or 230 Volts AC/DC or 230 Volts D.C. These will give enough clue to know whether the house is fed by D. C. or A. C. If the neighbour's set is AC/DC set, then it will be doubtful to know correctly whether the house is on A.C. or D.C. because such a set will work on either of the currents. In such cases the neighbour should be asked whether his set works irrespective of the Main Plug Pin positions. When an A.C./D.C. set works irrespective of the Main Plug Pin position, it is definite that the supply is A C. But if the set refuses to work in one position of the plug and if it necessitates reversing, it is an indication that the supply is D.C.

(*b*) We should have a look at our electric meter and find out what is written on it. The meter for D.C supply will have a nameplate bearing the following words and signs :

Direct Current
230 Volts

or

220 Volts =
The sign = means D. C.

The meter for A C. supply will have a nameplate bearing the following signs and words:

Single Phase
230 Volts A.C.
or
Single Phase
230 Volts
or
230 Volts ∽

The sign ∽ means A.C.

(c) We can get in touch with the Electric Supply Co. and ask for the desired information.

CASE 9

Under no circumstances should we allow our radio set to remain idle for long periods. For example, when we leave our town and go for outing for more than a fortnight, we generally leave our set behind. This means the set will not be operated till the time we come back. And when we come back, mostly it will be found that the set is behaving erratically. The reason is that the set was not operated for a long time and so the daily warming which was absent, gave on opportunity to the moisture to accumulate in the various components of the radio. And this absorption and accumulation of moisture is very dangerous to the life of a radio. Furthermore, keeping the set like this for a long time gives no hindrance to the 'eating up of component' by the cockroaches etc. Therefore, if we have to leave town

for a considerable period, we should hand over our set to some of our friends with a request to work it atleast for an hour or two daily. But it should be ascertained first that the friend is a license holder. If such a friend is not available, keep full trust on the radio dealer from whom the set was bought, and entrust this work to him. Specially in rainy season, the set should never be allowed to idle for a long time.

CASE 10

Many of the AC/DC sets have a resistance cord attached to it. This is attached to the mains cord of the set by means of a plug. On occasions when the set does not light up after switching on, many of us suspect some trouble with this resistance cord, whereas the actual trouble is inside the set. Suspecting some trouble with the cord, we remove it and connect the set directly to the mains cord and this results in considerable damage to the radio set. In some cases the resistance cord is removed and ordinary flexible wire of equal length is put instead, thinking that the flexible will serve the purpose. This too is harzardous and should never be attempted. In all such cases the safe practice will be to consult the radio dealer and not to tamper with the set.

CHAPTER XI

FACTS ABOUT BATTERIES

In villages or places where electrical power is not available, recourse for the operation of radio sets has to be taken from such a source that will transform something into electrical energy. Such a source is battery. An electrical battery is a device for transforming chemical energy into electrical energy, and, essentially consists of two different metallic electrodes or plates immersed in an electrolytic solution. There are many combinations of metallic electrodes and solution that are in use. The battery having rechargeable electrodes can be used over and over again after recharging. Such rechargeable batteries are called Storage Batteries, and are commonly used for radios, motor cars etc. There are other batteries having electrodes that are not rechargeable. These batteries are called Primary Batteries or Dry Batteries. This type of battery is not able enough to deliver current at high rates.

There are thus two sources from which we can operate our radios in places where electricity is not available, provided of course, our radio is meant for operation on battery. The present trend in commercial radio sets is to design a set that will work on electricity as well as a battery, by simple manipulation of a switch.

The source of primary battery proves a bit costly one in the long run, but it has its attendant advantages. Because of its attendant advantages some of the manufacturers have put on the market some really universal type of sets that will run on A. C., D. C. or dry battery. Look at the unique advantages such a set offers to us. Having once bought a set like that it does not matter whether we shift from an A. C. locality to a D. C. or vice versa. The same old radio will entertain us. The moment a picnic is projected, this radio becomes handy to be carried over as an item of entertainment at the picnic. With a fast-moving research in the manufacture of low consumption valves, some new valves have come up on the market that are aptly suited for dry batteries. And there is every hope that the dry battery may not prove much of a financial burden to the user.

That means, with the low consumption valves the dry battery will last longer but this does not satisfactorily solve the difficulty of replacement. The dry battery blocks that are employed in the sets are very compact in size and unless we get a replacement battery of exact size and correct voltage rating, the replacement will be a problem. Generally, the agent who supplies the set to us, carries spares ; but it is very imperative that before the set is bought we should make thorough enquiries about this and the probable cost of such a battery. In absence of suitable spares, large and odd sized battery of same voltage specification as that of the

original one, can be used but the advantages of portability are entirely lost.

For constant everyday use, a radio operated from a 6 volts storage battery is much more economical and less bothersome except for the arrangement for charging.

Fig. 1.
A 6-Volt Motor Car Battery.

We will now try to understand the action of a battery and then proceed to discussions regarding the charging of batteries.

The 6 volt battery commonly used for motor cars and radios, consists of three cells of 2 volts each. Each cell has two kinds of plates (positives and negatives) immersed in a solution called Electrolyte, which is nothing but a mixture of sulphuric acid and water.

When a cell is being discharged, the current is produced in the battery due to chemical action between the sulphuric acid and the active material of the plate. The plate which has a tendency to deliver current is called the 'positive' plate and the other 'negative.' During discharge, the strength (specific gravity) of battery goes down and down. When a battery reaches a certain value of specific gravity, it is said to be completely discharged. And when such a condition is reached, the need for recharging the battery becomes evident. In

recharging a cell, direct current must be passed through the battery in a direction opposite to that of direction of current during discharge. This reversal in the direction of the charging current, will naturally reverse the action which took place in the cell during discharge. During the discharge, we have seen that the active material of the plates combines with the acid of electrolyte, i e. sulphuric acid, and lowers its specific gravity. Therefore, during a charge, the acid is again liberated from the plate and returned to the electrolyte. When all the acid has been liberated, the strength (Specific Gravity) of the battery will again become normal, and the battery will be said to be in a fully charged condition.

When purchasing a battery we have to be sure that it is of a well-known make such as Exide, Willard, U.S.L etc. and the next important point on which we should rivet our utmost consideration is its Ampere-Hour Capacity. The capacity of a battery is the measure of the length of time for which the battery can deliver a certain amount of current, at a useful voltage. Multiplying the current delivered by the number of hours for which the current is being delivered is called the Ampere-Hour Capacity of a battery. For example if a battery can give 1 ampere current for 20 hours, the Ampere-Hour capacity of the battery is 20 and if the battery gives half ampere current for 40 hours even then the Ampere-Hour capacity is $(40 \times \frac{1}{2}) = 20$. A 100 Ampere-Hour Capacity Battery can give 1 Ampere

current for 100 hours or 5 Ampere current for 20 hours or 10 Ampere current for 10 hours. Higher the ampere-hour capacity better it is; and we should make it a point to buy a battery with as much Ampere-hour Capacity as our pocket would permit. According to the battery engineering, the life of a battery is roughly calculated in cycles. Battery once charged and discharged is equivalent to one cycle. Similarly, a battery which has been charged twenty times, and discharged twenty times will be said to have completed twenty cycles. Experience shows that under normal operating conditions batteries rated at 100 to 200 ampere-hour capacity will give service effectively for about 100 to 125 cycles. Type of batteries that are rated at 300 ampere-hours can give efficient service for about 200 to 250 cycles. Obviously, therefore, if the ampere-hour capacity of the battery is more it will require changing less frequently. This will mean fewer cycles of charge and discharge, and the ultimate result will be longer life to the battery.

Let us now take a concrete example and work it out. Say, we are out in bazar to buy a battery for Zenith Radio Model 6 J 230. The technical data which is given along with the set, indicates that the battery consumption of this particular model is 2.04 Amperes. The simple meaning of this is that as soon as the radio is switched on, the battery delivers a current of 2.04 Amperes. Suppose our choice falls on a 100 Ampere-Hour capacity battery. Such a battery will give efficient

service for this Zenith Model for a period of about $\frac{100}{2.04}=48$ hours. If we use our radio daily for about 6 hours, our battery will be in a fully discharged condition on the ninth bay. As said above, a 100 ampere-hour capacity battery will roughly have a life of 100 cycles, and since our radio demands one cycle every eight days the battery should last for $8 \times 100 = 800$ days, provided it is not misused. On the other hand if we had decided to buy a 300 ampere-hour battery, the entire aspect is at once changed. Such a battery would give good service for a period of $\frac{300}{2.04} = 144$ hours. And as in previous case, if we are using the radio daily for six hours, this battery will be in a fully discharged condition on the 25th day. The 300 ampere-hour battery will roughly have a life of 200 cycles, and, since our radio demands one cycle every twenty four days, the battery should last for $24 \times 200 = 4800$ days, provided it is not misused. Therefore, always insist to have more ampere-hours. Initial cost may be higher, no doubt, but the running cost will be definitely lower.

After having bought a battery set and a battery, the next problem that always confronts us is regarding the arrangements for charging the battery. There are possible solutions to this problem, and we will study these one by one.

(i) *Place having a battery charging station.* In many of the towns and villages thers are such

stations. Specially if the town happens to be a terminus for some motor service, there will be some arrangement at the workshop of the motor company for charging of the batteries. The workshop may charge a flat rate of few rupees for every charge.

(ii) *Places which are suburbs to big towns.* Such places will have a frequent communication to the big town either by road or railway. In that case it is advisible to send it or take it to the town for charging.

(iii) *Places having no charging station and for away from big towns but happen to be connected by Motor Transport.* In such places arrangement may be made with the Motor Transport Company for the charging of the battery. The buses of such companies ply long distances at good speed and the battery can be charged by the generator in the bus. It is, however, possible that due to neglect of the bus-driver the battery may not be properly charged. But even then it is a consolation to certain extent to be able to hear music or news in the quietitude of the village.

(iv) When none of the facilities mentioned under i, ii and iii are available, we have to make up our mind to purchase some kind of battery charging appliance. One such kind of appliance

is known as *Windcharger* which is shown in Fig. 2

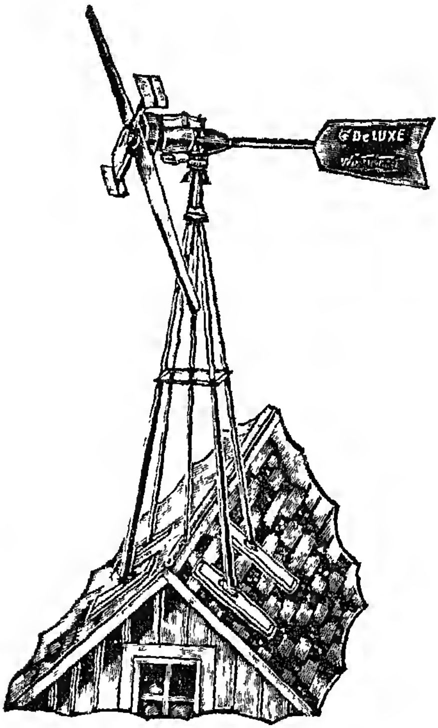


FIG 2
Windcharger

In the windcharger, the battery charging dynamo is made to run by taking advantage of the velocity of wind. The wind blows at some velocity which is rarely below 6 miles per hour. Windchargers that work efficiently on

as low a velocity as 6 to 8 miles per hour, are available on the market. This method of charging has come to stay as the most economical method of battery charging because once the windcharger is installed there is practically no expense except by way of distilled water that has to be put in the battery occasionally. The wind charger towers are available in different heights. The heights of 5 and 10 feet are mostly preferred. Greater height of the tower is of course advantageous. The cost of such windchargers is about Rs. 150 each (pre-war). Complete instructions as regards installation, operation and maintenance of these wind-chargers are supplied with the machine itself.

(v) Gas Electric Plant is another type of appliance that can be used for battery charging as well as farm lighting. It gives an output power of about 300 watts A.C. useful for lighting ten lamps of 30 watts each; and, 200 watts D.C. output for charging the battery. The dynamo is driven by a 5/8 Horse Power engine fitted with a mechanical governor to maintain a constant speed of 1800 rpm. It is aircooled and operates for 12 to 16 hours on one gallon of petrol. It can be started either by the mere pressing of a push-button (as is used for call-bells) or by rope.

(vi) Yet another type of charger is the gas engine driven battery charger which is very compact and handy. It is exclusively for battery charging; and operates for 8 hours on two quarters of gasoline. It costs about Rs. 200/- (pre-war).

If any of the first three systems is adopted our duty would be to see whether the battery is perfectly charged. It is desirable to check the battery voltage and also the specific gravity or the strength of the battery. Mere checking of the voltage is not a complete test. Because it often happens that the voltage may read correctly 6 or 6 2 volts and yet the battery may not show the same voltage when the load is connected to it. The other way round, if the specific gravity is checked, and found to be correct, the battery voltage will not go down on load (on load means when the radio is connected and operated from the battery). A hydrometer syringe shown in Fig. 3 is used to check the specific gravity of the battery. There

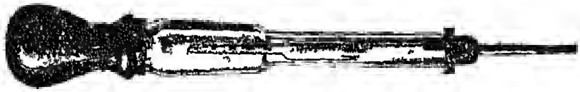


Fig. 3

are graduations marked as 1100, 1150, 1200, 1250, 1300 on it. For taking the reading of specific gravity we have to insert the rubber tube in the cell, squeeze the bulb and then slowly release it drawing enough electrolyte from the cell to float the hydrometer freely. The reading on the stem of the hydrometer at the surface of

the liquid is the specific gravity of the electrolyte. After this, the electrolyte must be returned to the cell from which it is taken. A hydrometer reading should not be taken immediately after adding distilled water, because in so short a period water will not properly mix with the electrolyte which is already in the battery; and the reading obtained will be incorrect. A faulty indication of reading might be obtained if the hydrometer is broken, cracked or leaky. Moist paper scale and vapour on the inner walls of the hydrometer float are sure signs to indicate that the hydrometer is leaky. A fully charged battery should give a reading of somewhere between 1.25 (1250) to 1.28 (1280) and a fully discharged battery will show a reading of somewhere between 1.2 (1200) and 1.15 (1150). Fig. 4 shows the full charge and discharge readings on hydrometers.

When a battery is purchased we must insist on the dealer or the agent to tell us the correct charging rate of that particular battery.

It is often required to add water to the battery, to keep the plates fully immersed in the electrolyte. Since electrolyte is nothing but a mixture of water and sulphuric acid, it is but natural that some proportion of the water is lost due to evaporation. Acid is never lost like this. To make good the loss of water by evaporation, we have to add water which is perfectly pure. Only distilled water is recommended. Distilled water bottles are available in the market.

On rare occasions a battery may require to be replenished by electrolyte itself. When some electrolyte

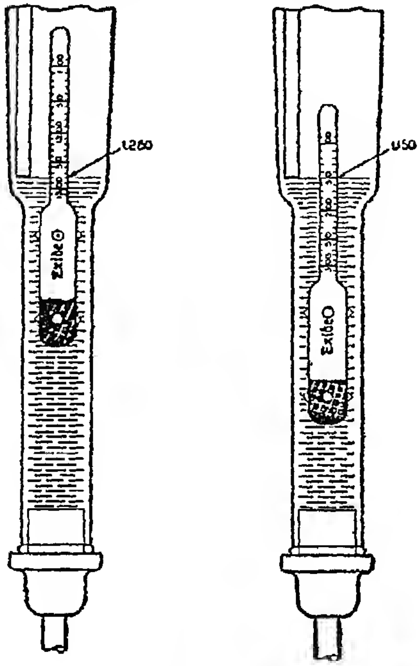


FIG. 4

1280—Full Chrage Reading | 1150—Full Discharge Reading

is spilled or lost from the cell we have to add some more electrolyte. Electrolyte consists of a definite mixture of pure sulphuric acid and distilled water. When electrolyte of proper strength is not on hand, it can be prepared by mixing chemically pure sulphuric acid with distilled water. The acid may be of 1.4 (1400) specific gravity.

For full strength or concentrated acid (1.8 or 1800 sp. gr.) following table gives the parts of water to be mixed with each part of acid to prepare electrolyte of any desired specific gravity.

Desired Specific Gravity of Electrolyte	Parts of water for 1 part of acid
1.400 (1400)	1.5
1.300 (1300)	2.5
1.200 (1200)	4.25
1.100 (1100)	9.5

Very special attention is drawn to the following important points to be very strictly observed while preparing the electrolyte. Any negligence whatsoever is bound to result in personal injury of a serious nature.

(a) Use a Pyrex glass, glass or China earthenware or lead vessel.

(b) Slowly, gradually and carefully pour acid into water. Interrupt the pouring very frequently and stir thoroughly with a clean wooden paddle.

(c) *Never pour water into acid. If this is done, excessive heat is generated and sputtering takes place. And this results in personal injury.*

(d) Allow the mixture to cool before adding it to the battery.

CHAPTER XII

AERIALS

It is sometimes stated that much advantage can be derived from special types of aerial for short wave reception. But some of these special types of aerial can give satisfactory result only for a particular wave-length for which it has been designed For example, let us consider the type known as " Half Wave Aerials" These aerials are desigued on the basis of wave-length to be received. Supposing we desire good reception on 25 metres then the length of this aerial will have to be $12\frac{1}{2}$ metres. And then the reception on 25 metres will be very much brighter than what it would be on 19, 16 and 13 metres. This is one difficulty about these special types and there is yet another of connecting it to the set. Necessary arrangements have to be made in the receiver to connect this aerial to a suitable place on the receiver aerial coil.

For considerations stated above, the special types of aerial have not seen their way to popularity. It is the "Inverted L" type of aerial shown at 3 in Fig. 1 which has become extremely popular due to its simplicity of construction and satisfactory uniform reception on all bands. Meterial required for such an aerial is shown in Fig. 2 and essentially consists of the following things.

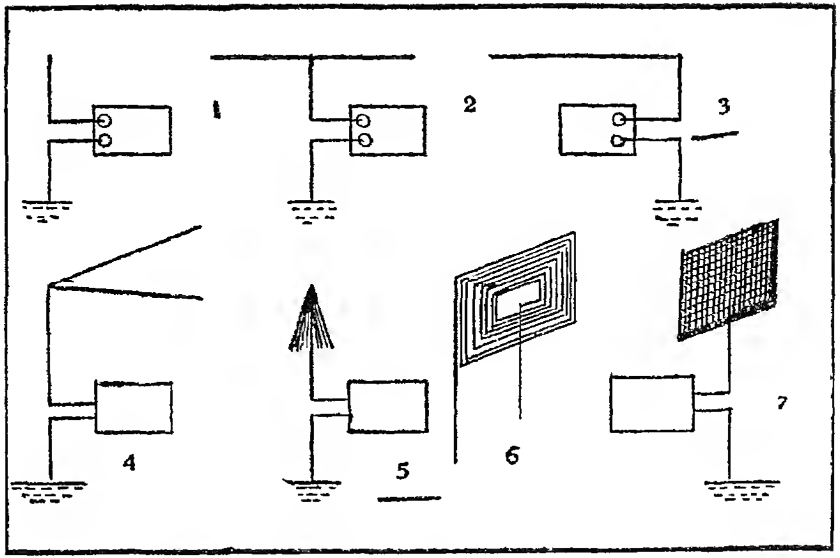


Fig. 1

Showing different types of Aerial

1 Vertical Aerial	3 Inverted "L"	5 Umbrella Aerial
2 'T' Aerial	4 'V' Aerial	6 Frame Aerial
	7 Wire-net Aerial	

Aerial wire (Enamelled or Insulated)
Lead-in wire (Insulated)
Insulators (Egg type)
Hook Insulators
Lightning Arrester
Aerial Earth Switch
Window Lead-in Strip
Earth Strap
Earth Wire
Bamboos.

FIG 2.

If the listener is on the ground floor, the length of the aerial need not be more than 30 to 40 feet, because in that case the lead-in wire, which is of considerable length, helps the reception. If the listener happens to be on the top floor of a building, the lead-in naturally will be shorter (about 20 feet) and therefore it is advisable to have a 40 to 50 feet aerial. If it is neither the ground nor the top floor, 40 feet length will suffice.

Direction of the aerial has a great effect on the reception. In this country North-South direction has been known to give best results. But there are aerials that give good results even in East-West direction. The

locality, and the geographical position have also to be considered.

Lightning Arrester is very important and every listener must insist upon the dealer for this. Specially in monsoon, when the radio is switched off, the aerial should be connected to earth by operating the aerial-earth switch. This is a safety measure against the disastrous effect of lightning.

On a powerful receiver, good reception can be had from an indoor aerial stretched decently across a room. We get "Insulator Pins" in the market, to fix such an aerial. We have to fix one such pin at each corner of the room and run the aerial wire through them. Insulator Pins are shown in Fig 3.

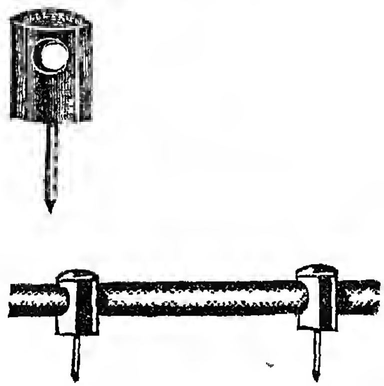


FIG. 3

Besides this there are ready-made "Indoor Aerials" available too. One such aerial is shown in Fig. 4. It

is made of woven tubular net of pure electro-copper $2\frac{1}{4}$ inch in diameter. It is usually available in 9 feet length and costs about 4 to 5 rupees.

FIG. 4.

In Figs. 5, 6, 7, 8 are shown various types of auto-aerials for motor car radios.

FIG. 5

Bumper Antenna

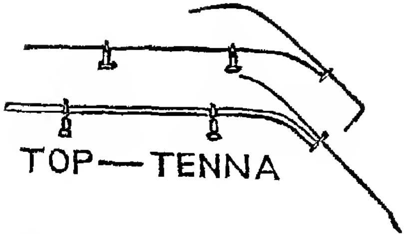


FIG. 6.
This type of antenna can be mounted on any auto-top by means of suction cups.

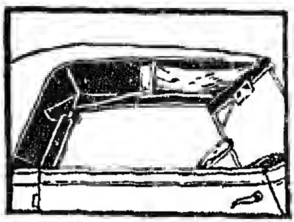


FIG. 7.
Flexible Convertible Antenna for Convertibles and Roadsters

It slips over the top braces, being sandwitched between the braces and top material of hood.

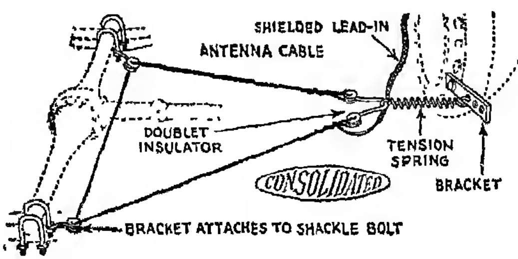


Fig. 8
Undercar Auto Antenna

CHAPTER XIII

WORLD—TIME

The riddle of the world-time is very amusing and interesting. No two cities of the world will have same time for a particular hour of the day. It must differ by few seconds, few minutes or few hours. The greater the distance between the two cities, the greater will be the difference in time.

When people in England will be enjoying their evening games, we in India will be snoring in our bed rooms, and the dinner at night in U. S. A will coincide with our morning tea. Why point out far off places like England and U. S. A., when even Calcutta and Bombay record a time difference of few minutes?

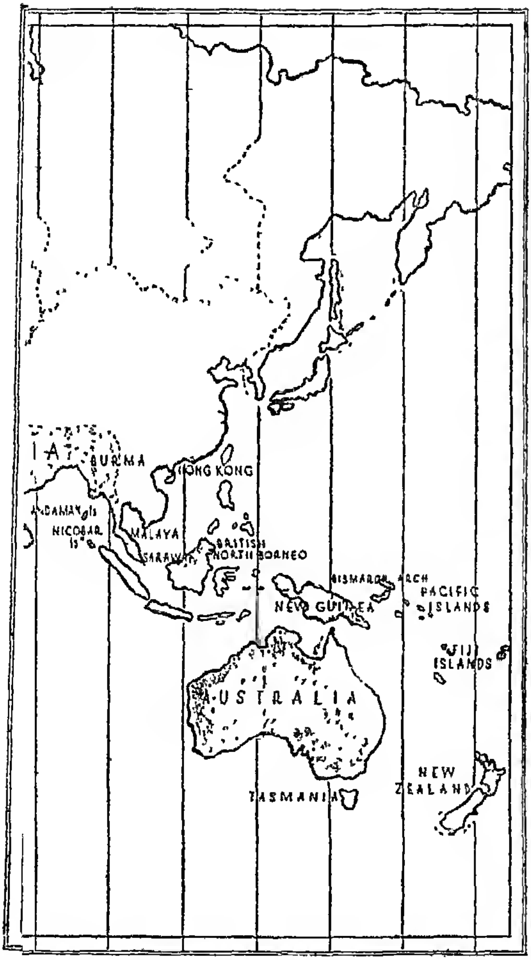
World-time problem apparently appears very insignificant but assumes potential importance when the foreign broadcasts are concerned. We may miss the pick of the broadcasts if we are not in the know of world-time. We may read in an advance announcement in the newspapers announcing that Mr. Truman will broadcast a talk to the world on 27th May at 8 P.M., and, if we lack knowledge of the correct world-time there will probably be no possibilities left, to enable us hear Mr. Truman's broadcast talk, because we will try to tune in that particular U.S.A. Station at exactly 8 P.M. on the 27th May.

All our labour will be lost and moreover it will be a great disappointment to miss the broadcast. If on the other hand, we have the correct knowledge about world-time, we will never tune our radio at 8 P. M. on 27th May but do so on the 28th May at about 6–30 A. M. in the morning. Similarly, if Mr. Churchill is to broadcast a talk say at 3 P. M. on 14th August; knowing the world-time, we would be prepared to tune in London at about 8–30 P. M. on 14th March and not at 3 P. M. as we would otherwise do.

The listeners, therefore, should possess definite information about timings in the different parts of the world. A time-zone map of the world is very handy for reference of this nature. One such map will be found on the previous page.

The map will afford a rough guidance in the matter of world-time and the following table will serve as additional help.

Bombay	London	New York	Berlin-Paris
8–30 p. m.	3 p. m.	10–30 a. m.	4 p. m.
Bombay	Tehran Madagaskar	Hong Kong	Honolulu–Hawai
8–30 p. m.	6 p. m.	10–30 p. m.	4 a. m.



- +6 +7 +8 +9 +10 +11 +12 HOURS

-MPIRE

Bombay	Cape Town	Singapore	Sydney–Melbourne
8–30 p. m.	5 p. m.	9–30 p. m.	12–30 a. m.
Bombay	New Zealand	Mexico City	Los Angeles
8–30 p. m.	2 a. m.	9 a. m.	7 p. m.

CHAPTER XIV

HOW TO SELECT A RADIO

Types, varieties and makes of Radio Set are so numerous that prospects find it very problematic to select a radio set. The alluring advertisements, attractive piebald catalogues and the every day influx of new names and makes more than confuse the average prospect when he is out to select a radio for himself. In such a confusion, the prospect oftentimes buys a radio set that he never wanted to purchase. Self-styled radio experts are many now-a-days and it is they who simulate an ability to guide the prospect in the selection of a radio set. These so called radio experts cannot be blamed too much because after all it is the prospect who alone should be responsible for the misjudgment in choosing his adviser in the matter.

The most successful and beneficial method, to combat this appalling state of affairs, would be to equip ourselves with such facts and figures that will guide us in the selection of a radio set. And to get equipped in such a way, we have to know the minimum requirements of an avarage good radio set.

A radio set must be selected after studying it from about fifteen different angles. Each angle has its own importance, and no consideration, however insignificant it may look, should be ignored. If we carefully study

the following fifteen points, our task of arriving at a quick decision will be more than done:—

(*a*) Power Supply
(*b*) Power Consumption
(*c*) Wave Range
(*d*) Power Output
(*e*) Tuning Control
(*f*) A. V. C.
(*g*) Selectivity
(*h*) Sensitivity
(*i*) Spare Parts
(*j*) Make
(*k*) Cabinet
(*l*) Price
(*m*) Pick-up Connection
(*n*) Extension Loud Speaker
(*o*) Tuning Scales (Dials)

POWER SUPPLY

We should ascertain the type of power supply we have in our house. If the supply is A.C. and when it is sure that we may not be required to shift to an area having a D.C. supply, our requirement in this matter would be an A.C. set. Next consideration would be about the voltage and frequency. Most of the towns in India have a power supply of 230 volts at 50 cycles frequency,, but there are some places like Baroda, Kashmir etc. where we find power supply of 110 volts at 40 cycles or 25 cycles. Ninety-nine per cent of the

radio sets can be operated either on 110 or 240 or any intermediate value but such is not the case as regards its frequency. Mostly all the sets work on 50 cycles frequency but there are some that are equipped with transformers for 25 cycles as well. A radio set rated for 25 cycles operation can be operated from a 50 cycles supply source without any harm; but a radio set rated only for 110 volts operation cannot be worked on 230 volts. A radio set rated for 50 cycles should never be operated on 25 cycles or lower.

In case we have a D C. supply it is advisable to go in for a universal (AC/DC) set that will work on AC as well as DC.

POWER CONSUMPTION

Any radio, whether it is operated on A.C. or D.C. supply, consumes some electrical power. The power consumption of AC/DC radios is more. The more the number of valves, more will be the consumption. All the technical pamphlets describing a particular set give reference to this item and specify the power consumption of the set. This figure should be carefully studied and by use of tables on pages 81-84 a rough estimate of monthly charges should be worked out and then only a decision should be taken on this point.

WAVE RANGE

The most popular and easily understandable definition of an All Wave Receiver is a set capable of receiving all stations broadcasting on any wave-length

that is covered up from 13 to 500 meters. On pages 57–60 of this book, a list of important wave bands is given. This will serve as a good guidance on this point. We should first decide as to which broadcasts we are interested in.

If we are equally interested in all foreign broadcasts and the Indian broadcasts, our requirement will be a set having a wave range from 13 to 550 meters. If on the other hand we have no interest in foreign broadcasts, we may have to buy a set that will cover up all the Indian Stations. This means our requirements would be a set having two bands—Medium or Broadcast and the Indian Short Wave band. And then there are persons who are content only with local reception.

A set for local station reception will evidentally be cheapest, A two-band set will be costlier than the local set and for an all wave set we have to pay the most.

POWER OUTPUT

The last valve (or valves) is connected to the loud speaker and the purpose of this valve is to produce power. The unit of power is called WATT and, it is the practice to give the rating of the output valve in terms of watts or milliwatts. One thousand milliwatts is equal to one watt. An average battery set with an ordinary output valve may give 200 milliwatts ($\frac{1}{5}$ th watt) output, whereas a battery set with a special output valve may give an output of 500 milliwatts i.e. half a watt or even 1·75 watts. The

average receiver operated from electric mains gives an output of from 2 to 3 watts. This is more than enough when it is definite that no extra loudspeakers are to be used as extension loudspeakers. When such speakers have to be used, it is always better to have a set with an output of 5 watts or more. There are radio sets with an output of 10 watts too. This high output of the receiver is a distinct advantage for listening foreign stations of low power (i. e. weak stations) and also for enabling the use of 1 to 3 extension speakers in different rooms.

TUNING CONTROL

When selecting a radio, it must be ascertained whether slow motion or vernier tuning is provided. Slow Motion Tuning is absolutely essential for tuning in short wave stations. If the tuning knob is not geared down sufficiently we will find it extremely difficult to tune in short wave stations satisfactorily. Let us take an example. The short wave band on a radio, say extends from 13·9 metres to 30 metres. Expressed in Kilocycles, the range will be from 21,600 to 10,000 Kilocycles. i. e. 21600—10000 = 11,600 Kc/s. Out of these only 600 Kc/s are allotted to broadcasting.

(A)	21,550 to 21,450	=	100	Kc/s
(B)	17,800 to 17,750	=	50	Kc/s
(C)	15,350 to 15,100	=	250	Kc/s
(D)	11,900 to 11,700	=	200	Kc/s
		Total	600	Kc/s

Now if the tuning scale is six inches long the smallest of the above bands which is 50 Kc/s (B) will occupy three hundredths of an inch on this dial and in such a small space there are four broadcasting stations that are to be tuned. Imagine what a task it would be to tune in these four stations in a space as short as three hundredths of an inch, if there is no slow motion provided for the tuning control.

A. V. C.

Almost all the sets on the market are now equipped with Automatic Volume Control. The function of this device is to control automatically the amplification or the volume of the receiver. The amplification increases automatically as the signal gets weaker and vice versa, and this results in a constant output of the receiver over a relatively wide range of signal strength. This means that such stations which would normally fade very badly, are kept practically constant due to A. V. C. It is, however, a mistake to think that A. V. C. is a complete cure for fading.

SELECTIVITY

In average receivers the degree of selectivity is 10 Kilocycles. The simple meaning of this statement is that stations that are 10Kc/s apart can be tuned in without any mutual interference. In some sets there is a provision of variable selectivity. This is of course an advantage. But a receiver fitted with this device will be costlier too.

SENSITIVITY

Number of valves should never be considered a criterion of sensitivity of a receiver eventhough it may give some indication to that effect. It is possible that a 6 valve receiver may be more sensitive and powerful than another having as many as ten or twelve valves. The six valve receiver may have only six valves, but three of them might be serving the purpose of actual nine valves. The modern practice in designing of valves is to combine the function of two or more valves in one glass envelope. Some third class manufacturers go to the extent of increasing the number of valves unnecessarily by having separate valve or even two valves for one function. Where one rectifier could have been used it will be found that two are used. Instead of using one double-diode-triode valve some manufacturers use a separate diode and a separate triode. Therefore, we should never compare any two receivers on the basis of number of valves. The best practice would be to ascertain the number of stages rather than the number of valves.

Sensitivity of a radio receiver is that characteristic which determines minimum strength of intput signal capable of giving a desired value of output signal. So to say, a highly sensitive receiver must receive weak station very satisfactorily, Generally below 20 metres the sensitivity is not great enough, and we find a lot of noise generated in the receiver itself. Therefore, it is advisable to select a set having atleast one R. F. Stage before the frequency changer valve.

SPARE PARTS

We should amply make sure that the set which we decide to buy, has an abundant spare parts supply. As far as American receivers are concerned they have a greater degree of interchangeability of parts than the European receivers. Some of the British Manufacturers like Marconi, H. M. V. are now using valves of international type. Even Philips is equipped to-day with international type of valves. By international type it is meant that American equivalents can serve for replacement purposes.

MAKE

It is always advisable to buy a set made by a well-known manufacturer. However, much difficulty has been experienced by many, in ascertaining the well-known makes. Every dealer or agent loudly acclaims that the brand, he is dealing in, is the best. And it is very difficult and sometimes impossible to get correct advice from agents or dealers who are handling a particular make of radio sets. But much faith can be put in those service agencies who are only conducting service workshop and do not happen to have any agency for any particular make. These service agencies are working daily on the repairs to different makes of radio sets and it is they who have the real comparative study of different defects in each make of radio sets, and consequently they are in a qualified position to advise on such matters. They have to study the different receivers of various makes completely and they know all the ins

and outs of every make. Therefore, always rely on such agencies for selecting the make. Do not be carried away by the pomp and show displayed by a dealer.

CABINET

The choice of this will entirely rest on individual taste and liking. There are two main varieties. One is horizantal and the other is vertical type, Some may like the horizontal shape and others may like the vertical pattern. Some cabinets are made of bakelite whereas some wooden cabinets are veneered. The bakelite cabinets look smart and decent but the chances of damage are more. Of the wooden cabinets, the tropic-proof variety should be selected.

PRICE

This item will more or less depend on our requirements. If we require a local set, the price will not be too much. For an All Wave Set, the price will be naturally more. Then again a well known make will be costlier than an unknown make. In this connection something very interesting is reproduced below which has been picked up from a direct mail circular of a famous business house.

> "When you buy on price you can never be sure: It is unwise to pay too much but it is worse to pay too little.
>
> When you pay too much you loose a little money—that is all: but when you pay too little you sometimes loose everything, because the thing you bought is incapable of doing the thing it was bought to do.
>
> The common law of business balance prohibits paying a little and getting a lot.

It can't be done!

If you deal with the lowest bidder it is well to add something for the risk you run, and if you do that you will have enough to buy quality."

There is plenty of meaning in it and is worth serious consideration when buying a set.

PICK-UP CONNECTIONS

When buying a set, we should make sure that arrangement for reproduction of gramophone records, has been incorporated in it. The present trend is to provide this on every model. But there are some makes and some models that do not incorporate this arrangement.

EXTENSION LOUD SPEAKERS

When it is desired to hear programmes in two different rooms, we must have either two radio sets or one radio set and one extension speaker. Mostly all continental sets have arrangements for connecting such an extension speaker, but the normal practice with American manufacturers is not to provide these connections.

TUNING SCALES

The modern trend is to have a horizantal scale distinctly marked in kilocycles (KC) on the medium wave band and megacycles (MC) on the two short-wave bands. Additional markings in meters and station names is certainly an advantage. The tuning scale should be as long as possible so that the short-wave

stations do not get crowded together. Tuning scale of 9 to 12 inches in length should be acceptable.

Now a days we find many radio sets having bandspread scales. The simple meaning of bandspread (or spreadband) scale is that each band of 13, 16, 19, 25, 31 and 41 meters is spread on the entire length of the dial. When we put the wave-change switch on 13 meter position, stations on 13 meter band alone will be received and so on. The advantage of bandspread sets is that it renders short-wave tuning very easy.

UNWANTED FEATURES

Radio sets having features such as automatic tuning, tuning indicators and such like, should be at once discouraged. These features do not serve any useful purpose. On the contrary the prices of sets having such features are unusually inflated. Then the question is why should we pay a higher price for things that are not only going to serve us in any useful way but are to be a source of nuisance.

CHAPTER XV

LIFE OF A RADIO SET

Imagine a sound healthy looking man of a very robust built placed before a doctor and a verdict demanded on the longevity of the man. What do you think would be the verdict of the eminent physician? He will say something that will be far from any thing definite. He may say: " Well: This man looks quite alright...possibly he may live easily for another twenty years...may be he may live longer...or his life may become short if any sickness befalls him." It all depends, the doctor would continue, on how his system works inside and how things get on internally. If the heart does not become weak, the intestines do not get ruptured, the kidneys function normally, the lungs behave properly then there is no reason why the man should not live long. This is how the doctor will reply in detail. But will we be satisfied? Not at all. But all the same we should not be cruel in passing strictures on the doctor because it is not the doctor's fault that he could not tell you anything definite about that man's life. On the contrary, anybody would blame us for asking such a naughty and perhaps silly question.

Similarly, if a brand new radio set of robust design (a set designed with a very liberal factor of safety) is taken to an eminent radio engineer and the engineer's verdict demanded about the life of the radio set, the

reply would be something that would run parallel to what the doctor had said in the case of the man. The engineer would say: "Well—the set looks alright, plays very well—possibly it may give you faultless service for atleast next five years—may be, it may be longer or perhaps it may fail earlier if some sickness befalls it." It all depends, the engineer would continue, on how the system inside works and how things move internally. If the valves do not become weak, the condensers do not get punctured, the resistors function normally, the transformers behave properly, then there is no reason why the radio set should not last longer.

What is meant to drive home by the above analogy is the fact that the life of a radio set is so uncertain that it is utterly impossible to forecast anything definite, —even 'Inner Voices' will miserably fail if they were to try a prediction on this matter.

Given a *good treatment*, a first class set should, on an average, give you a trouble-free service for atleast three years. If at all it develops some fault within the first three years, it will be of a minor type which may not overdraw from your purse. There are instances where radio sets of best makes have failed due to minor trouble during demonstration in showrooms. One instance of this kind is well worth mentioning. A seven valve set of good make was on demonstration at a customer's place. It failed during the first hour of its operation. The failure was due to a valve having

developed a defect. The result was that the customer concerned not only discarded that particular model but got so much unnecessarily disgusted that even today, six years now, he is heard vehemently condemning that make of the radio. This man then went in for another make. The radio of the condemned make was sold to another party after the replacement of the faulty valve, and was kept under observation, and it was found out that the set behaved properly for two years without even a minor complaint. And the set of the other make, which the man ultimately purchased, failed six times during a period of two years.

Another interesting case is well worth citing. Two similar models of one and the same make were sold to two persons on the same day. Both the sets were used under same climatic conditions and both the sets were given a good handling. One set failed after six months and the other gave a faultless service for next two years. The first set failed due to some condenser trouble. No one can account for this trouble. It was to happen and it happened—that is all.

Thermal agitation that is going on in the entire wiring and the different components, the electron movement in different parts and so many other physical, chemical and electrical actions and reactions that are taking place every second in various parts and components of a radio set make it all the more difficult for an engineer to say with certainty whether a particular component will last for a month or

a year, or more. Hundreds of components and parts such as transformers, coils, resistors, chokes, condensers, loudspeakers etc. constitute a radio set and naturally it is many times more difficult to say anything definite about the life of a radio set.

That particular make of radio is more durable than the other make is a mere game of hide and seek. Durable, less durable, more durable are relative terms and perhaps they only mean that the cost of repairs during two or three years on an "accepted-as durable" set will be lower than what it would be on a set which is labelled as less durable, in the same period. But the fact remains that a set, whether it is most durable or less durable, is bound to fail sooner or later and both have got to undergo repairs earlier or otherwise.

So the entire prelude boils down to the conclusion that every radio set, be it of any make, will invariably fail due to some minor trouble during the first three years; and afterwards, in the later years, it may frequently trouble us due to some major or minor faults. Expenses for the minor repairs in the first three years will be infinitesimal when compared to the expenditure that we may have to undergo after three years when the set is likely to develop major faults. Make it a point, therefore, to pause and think before taking our sets for repairs (after three years of use) to a service workshop. It is almost a certainty that the cost of repairs, conveyance charges and the energy and time that we may have to spend after the

repairs of the set in the third or later years may soar so high as to add up to the cost of a new set.

Is it not then wiser to get our radio exchanged with a new one at the end of or during the fourth year? Experience has shown that it is not economical to carry on with the same set for more than three to four years. Radio repairing is more or less a personalised business. An owner of a set naturally thinks of going to a place, where he has friends or acquaintances, to get his set repaired. And if we take an old set for repairs to agencies who happen to be our friends, seventy five per cent chances are that we stand to lose both money and friends. This reminds me of an old maxim: "If you loan money to a friend the chances are that you lose both money and friends." Something like this is likely to happen when a very old radio is sought to be repaired.

However, there are instances of sets working satisfactorily even after four or five years, but these are exceptions.

Therefore, in our own interest, we should follow the golden rule which reads:

"After three or four years of use get the Radio exchanged with a new one."

CHAPTER XVI

INTERFERENCE

When we are listening to a programme on a radio set, many a times we hear sounds and noises in the form of clicks, hisses and crackles which interfere with the radio reception so terribly that we get disgusted, switch off the radio and say "Damn this interference." These noises and sounds which interfere with the radio reception are termed as *Interference* in radio terminology. There is a tendency on the part of the public at large to call any sound or noise in a radio set, that mars the reception, as atmospherics but this is absolutely incorrect.

Interference can be divided in two main groups :—

1. Natural Group
2. Man-made Group

These two main groups can again be subdivided as follows :—

NATURAL GROUP

- Seasonal Interference
- Interference by
  - (*a*) Thunder-storms
  - (*b*) Wind-storms
  - (*c*) Dust-storms
- Lightning and Rain

MAN-MADE GROUP

- Interference originating in radio set itself
- Electrical Interference
  - Direct Radiated
  - Conducted
  - Mains Radiated
  - Re-radiated
- Interference from other stations or neighbour's radio

Let us consider the Natural Group first.

SEASONAL INTERFERENCE :—In summer, a special form of static interference is caused by hot air rising from the ground and charging our aerial with electricity. This sets the aerial in violent oscillation at resonant frequency thereby introducing interference.

INTERFERENCE DUE TO STORMS, LIGHTING AND RAIN :—It is a very well-known fact that clouds get electrically charged due to friction between water vapour they carry and the surrounding air. This condition gives rise to very high voltages which visibly or invisibly break down the insulation of the air. When the air insulation is thus broken the high voltages are induced in our aerial and result in interference. Rainstorms, duststorms, windstorms and ionisation by Sun's rays are also the sources where the origin of interference can be traced.

The Natural Interference (also called static or atmospherics) is heard in Radio Receivers in the form of

clicks, crackles, hissing and grinding sound. Severity of this type of interference increases with decreasing frequency of waves to which the receiver is tuned, and decreases with increasing frequency of the waves. For example it will be more severe when Delhi Station is tuned on 850 Kc/s than what it would be when Delhi is tuned on 9·5 Megacycles.

The interference from Natural Group is very difficult to eliminate. It can, however, be reduced by sacrificing the sensitivity of the receiver and using static eliminators or suppressors available in the market, but total elimination, without sacrificing any sensitivity, is an impossibility even today.

Having finished with the Natural Interference let us now divert our attention to Man-made Group and see what could be done about it.

INTERFERENCE ORIGINATING IN RADIO SET ITSELF—This interference is due to bad connections, defective tubes, condensers, resistances and transformers, This type of interference is of frying and sputtering kind and sometimes intermittent too.

INTERFERENCE FROM OTHER STATONS OR NEIGHBOUR'S SET—This type of interference gives rise to what are known as squeals and howls due to an oscillating condition of the neighbour's set.

ELECTRICAL INTERFERENCE—When switches are closed, a spark jumps or there is a sudden change in current carried by a wire. This creates a damped radio

wave which reaches the receiver and causes interference by an impact excitation. Sudden interruption or variation in operating current of an electric device sets up interference. In a locality where many electrical devices are used, multitude of noises would be heard in a receiver used in that locality. This interference can travel to our receiver by any one or all the following four ways:—

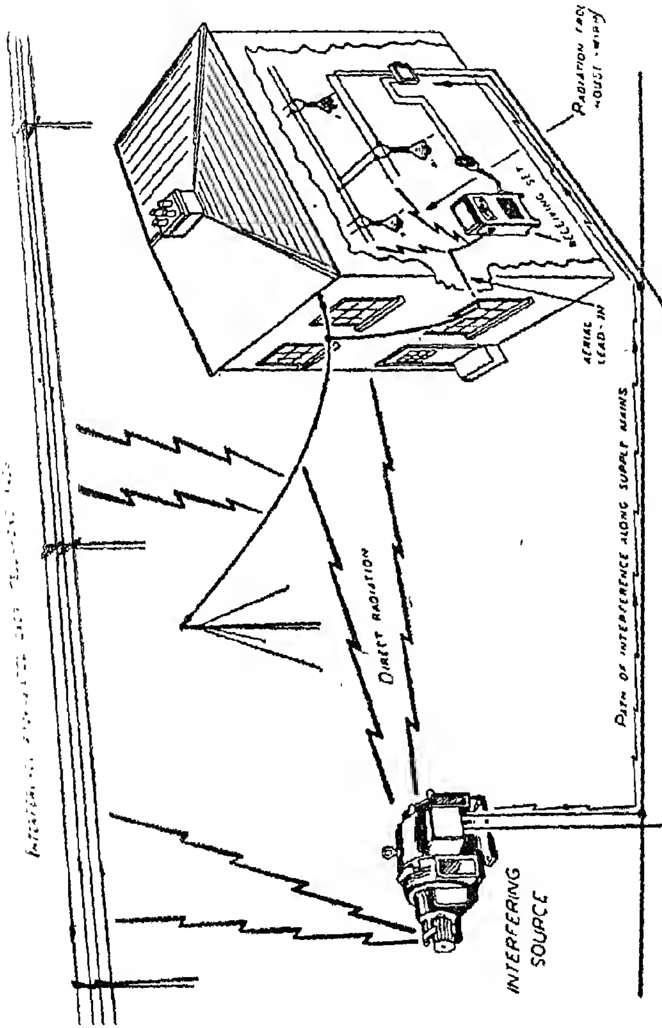
DIRECT RADIATED:—It is radiated directly from the source or offending machine and reaches our radio by way of the aerical.

CONDUCTED:—When the electrical interference travels by wire and enters the radio set through Mains Leads, it is called conducted interference. It can be either high frequency or low frequency in nature. High Frequency interference can be conducted for distances of many miles along electric mains, telegraph wires or other metallic circuits, and, is usually accompanied by mains–radiated interference. Low frequency conducted interference is mostly experienced in D.C. area along D.C. Mains. Battery Receivers are immune to this kind of interference.

MAINS RADIATED:—This type of interference enters the mains and gets conducted for a long distance and then radiates across to aerials from the house wiring.

RE-RADIATED:—This type of interference is re-radiated by Telephone wires, steel girders, drain

pipes, overhead wires, neighbour's house wiring and aerial etc. and enters the radio set through the aerial.



METHODS OF PROPAGATION OF INTERFERENCE FROM SOURCE TO RECEIVING SET

In Fig. 1 a picture is given showing how the different types of electrical interference find their way to our radio set, and, the list below shows some of the common electrical appliances that give rise to interference.

Telegraph Relays	Converters
Electric Motors	Neon Signs
Electric Fans	Flash Signs
Tram Cars	Buzzers
Automobiles	Electric Bells
Electric Trains	Lifts
Refrigerators	Battery chargers
Toy Electric Trains	Medical Diathermy Apparatus.
Electric Toys	Violet Ray Apparatus.
Humidifiers	Hair Dryers
Dry Shavers	X-ray Apparatus
Trickle chargers	Motor Generators

Unlike the natural group, every type of interference of the man-made group can be suppressed or eliminated. There are useful appliances available for this purpose. However, the difficulty is in deciding which form of interference is troubling us and not in getting the appliances from the market.

To distinguish one type of interference from the other, is a complicated affair but nevertheless we shall try to study some simple tests which could be carried out to achieve our aim. As explained above, natural interference is almost impossible to eliminate

unless the sensitivity of the receiver is sacrificed. This leaves us free to direct our attention to the man-made group of interference.

When interference is encountered it is advisable to be sure first that the Radio Receiver itself is not the cause of it. Bad and loose connections and joints are a source of frying noise whereas defective tubes give rise to Intermittent Buzzing. Removing the tubes one by one may sometimes help to locate the trouble. When the noise stops as a tube is removed, the noise starts at that stage or those ahead of it.

An indoor aerial, contrary to the general belief, also picks up noise since it is closely located amongst the sources of interference—i.e. the power wiring in the house. The indoor aerial then acts as an aerial coupling to the mains wires with the result that whatever noise the mains are carrying, is introduced in the set. Therefore, due to this coupling effect, the effective antenna will change when a lamp is switched 'ON' or 'OFF' somewhere in the house, causing sudden change in the volume of received signals. Many complaints have been reported where the volume of the receiver used to get changed by the operation of light switches in the house.

For those who can take advantage of a local broadcast, it will be helpful to disconnect Aerial Earth System from the set and see whether the interference persists, on local station. If the interference is encountered even then, one can be sixty per cent sure that the trouble is in the

set. Gentle and careful taps and knocks on the various components in the Receiver, may also lead to the discovery of the cause.

After having made sure that the receiver is faultless, we should proceed with further analysis. A sure, quick and reliable test for conducted interference is a battery set which does not pick-up interference of this type. But in case a battery set is not available, the aerial and earth connections should be disconnected and the aerial and earth terminals should be shorted. Having done this if the noise persists in retaining its strength, it is to be supposed that the interference is of conducted type. In case the noise completely disappears it is a positive proof that the interference enters the set through aerial, and, therefore, is of either direct radiated type or re-radiated type. If the noise becomes weaker then it is to be assumed that the interference is of mains radiated type or a combination of several types.

Interference radiated by power lines can usually be identified by tuning the receiver, starting from low frequency band going upto high frequency band. If the interference increases on high frequency band, the cause is direct radiated interference, and the offending machine is probably within 100 feet. On the other hand if the disturbance is worst on low frequency, then it will be a safe conclusion that it is carried by power line and re-radiated. In such cases the source may be far away.

These in short are the rough and ready methods of locating the interference. However, there are many electrical appliances that have their own characteristic noise which can be easily recognised by experienced engineers only.

Remedies to eliminate the interference can be classified under two heads :

(i) Suppression at the source
(ii) Elimination at listener's end

These are the two methods generally adopted to suppress interference of the man-made group, the first named being very efficient and a sure remedy. The second one, though not entirely effective, is worth a trial. Noise created elsewhere and conducted into the house by power lines, can be suppressed at the point of entrance of the wires in the house. But this will not prevent interference from devices working in the house itself. The type of filter or suppressor suggested for this can consist of two condensers, each of 2 mfd. in series across the line, with centretap earthed and necessary fuses inserted between each condenser and the line wire. The condenser leads should be short and an effective earth must be used.

Condensers used should be of non-inductive type and high voltage rating. These condensers differ from the ones used in radio sets. Ordinary condensers that are used in radio sets are usually tested on voltages varying from 500 to 1000 D.C. whereas the condensers

used for interference suppression work are tested on voltages varying from 1500 to 3000 Volts D. C. Besides this, these condensers incorporate three separate layers of thick dielectric and therefore are three times the size, weight and cost of ordinary condensers. A 4 mfd. condenser, used in a radio set, would be smaller and cheaper than a 1 mfd. condenser used in suppression work. The British Standard Specification specifies that the minimum insulation resistance of a suppressor condenser should be 150 Megohms for a 2 mfd. condenser, 300 Megohms for 1 mfd. condenser, 600 Megohms for a .5 mfd. condenser and 1000 Megohms for .1 mfd. and smaller condensers.

The very fact, that we sidetracked the main issue for a while and turned to the quality of suppressor condensers, is itself an indication that selection and use of quality condensers for suppression work is of even more importance than the actual elimination of interference. Much harm may be done to the machine and human life if one of these condensers were to fail and make the frame of the machine live. Therefore, unless we have the qualified assistance of experienced engineers, it is not worth anything to do the job ourselves and run great risks.

Now we begin from where we left. If the filter suggested above, does not bring in satisfaction or the noise is originating in the house itself, a filter at the point where the Radio is plugged, is worth a trial. This filter may have the same specification as above or

an alternative arrangement would be to use 1 mfd. condenser between the neutral and live wire and another 1 mfd. condenser between neutral and ground.

When it is found that only condensers do not prove effective, a combination of chokes and condensers should be tried. One milihenry choke in each line and 1 mfd. condenser before the chokes across the lines, and two .2 mfd. condensers in series across the two wires with centretap earthed and insertion of necessary fuses, should prove to be a good combination for choke condenser filter.

There are available, on the market, ready made suppressor filter units for different types of interference. Such units manufactured by Belling & Lee Ltd., London are strongly recommended.

However, let me strike a note of warning that unless we possess requisite knowledge of electrical and radio circuits, we should not carry out suppressor installation without the guidance of some experienced engineer.

CHAPTER XVII

WIRELESS LICENCES

It has been found that much confusion prevails amongst the public regarding the rules and regulations governing the licences which permit the use of a radio set. There are many who have no idea about the fees to be paid whereas there are others who know that a sum of Rs. 10 can secure a licence but unfortunately do not know the correct procedure that is to be adopted to secure the licence. Then again there are some persons who would like to know whether one licence can cover the use of more than one radio set in the same house. In short, there appears to be a dearth of correct information about the issue of licences and other related matter. The Post-office regulations governing the issue and use of such licences are given in the following few paragraphs, for the information of prospective listeners.

REGULATIONS

(Licences for domestic purposes)

1. Broadcast Receiver Licences authorise the use of wireless receiving apparatus by the licensee for private and domestic purposes only at the address specified in the licence. One licence covers the use of any number of wireless receiving sets by the licensee or his family at that address but a separate

licence is required by each holder of a separate tenancy in the same premises in respect of wireless apparatus used by him. The fee for a Broadcast Receiver Licence is Rs. 10 per anum and these licences are obtainable on application from all Head Post Offices and Departmental Sub-Post Offices included in Section XIII of Postal Guide. These licences may be issued to persons of any age, of either sex and of any nationality.

2. Broadcast Receiver Licences may be issued to cover the use of wireless apparatus in the rooms of clubs and similar institutions where the members constitute a corporate body and in hospitals, sanitoriums and educational establishments where the receiver and loudspeakers are installed in the public rooms by a responsible official for the free use of the patients, students and staff. A single licence issued for these purposes will cover the whole of a single set of self-contained buildings but wireless apparatus in each of the private residential quarters, even in the same building, requires a separate licence.

3. Broadcast Receiver Licences cover the use of wireless receiving apparatus in any part of British India and any areas in India States including Railway Lands which are administered by the Crown Representative and to which the Indian Telegraphy Act, 1885 has been applied. They do not cover the use of wireless apparatus in other parts

of Indian States or in foreign territory. The Indian Telegraph Act does not apply to the tribal areas of the N. W. F. P. and licences are not required for these areas.

4. Brodcast Receiver Licences may be issued for the use of one portable wireless receiver or for the use of receiving apparatus in a private motor car. In the latter case the applcation form must have the words " For use in Motor Car" written on it, and the registration number of the car inserted in the space provided for the location of the station. These particulars are inserted in the licence. Such licences only cover the use of wireless apparatus in the area indicated in para (3) above.

5. Licensees are required to communicate any permanent change in their address or in the location of the licensed station, to the issuing postmaster, at the same time returning the Broadcasting Receiver Licence for amendment.

6. If a current licence is lost the fact must be communicated immediately to the Post Master-General or Director, Post and Telegraphs, of the circle. A 'substitute' licence will be issued in replacement of a lost licence by the Post Master-General or Posts and Telegraphs of the circle on payment of a fee of Rs. 2 only. A 'substitute' licence remains valid during the unexpired period of the original licence.

7. The owner of a single licensed receiver may, without notifying the issuing postmaster move his receiver temporarily at his discretion for a period not exceeding three months at any one time.

8. A licensee who owns more than one wireless receiver must obtain an additional licence if he desires to remove one set temporarily to another address without dismantling his other set or sets.

9. A Broadcast Receiver Licence covers the establishment, maintenance or working of the licensed wireless apparatus at one place only at a time.

10. A Broadcast Receiver Licence is not transferable but in the event of the decease of the licensee it will be regarded during the unexpired portion of its currency as covering the use of wireless apparatus at the address of the licensed station only by any member of the deceased's family.

11. Broadcast Receivers Licences shall not be issued for the purpose of reproducing broadcast programmes for gain or in public rooms of hotels, restaurants, dance halls, shops or any business premises to which the public have access. For such purposes a Commercial Broadcast Receiver Licence is required.

12. Broadcast Receiver Licences shall not be issued to Municipalities or such like public bodies for the purpose of reproducing broadcast programmes by means of receiving sets and loudspeakers erected by them in public places unless sanction in writing

to such issue has been furnished by tbe Director-General of Posts and Telegraphs and is produced for inspection at the time of application. Municipalities and public bodies without the written sanction applying for such licences should apply to the Director-General of Posts and Telegraphs in the first instance.

13. Broadcast Receiver Licence covers experiments and instruction with wireless receiving apparatus for private and domestic purposes at a specified address.

14. For the benefit of persons who are required to tour extensively, a licence may be issued which is available throughout British India.

12. Amplifiers that can be only used for record playing or microphone work need not have any licence.

FOR BROADCAST RECEIVING SETS ON BOARD SHIPS

(1) *For ships equipped with commercial wireless installations*

Broadcast Receiver licences for such ships registered in British India are issued only to the shipowners and not to passengers or members of the crew individually. One such licence will suffice for broadcast receiving apparatus erected on each ship, and any shipowner desiring such a licence should apply to the

Director-General of Posts and Telegraphs, New Delhi, giving the name of the ship concerned.

The following special conditions are imposed in addition to the conditions printed on the licence :—

1. The use of a ship's main aerial for the reception of broadcast programmes is prohibited except when the ship is in port.
2. The broadcast receiving apparatus and aerial must not be connected in any way with the ship's main wireless installation.
3. The broadcast receiving apparatus must not be worked by the ship's wireless operator during his hours of watch.
4. Persons in charge of the broadcast receiving apparatus must sign the usual declaration of secrecy if by such use they become able to intercept private telegrams to and from the ship.

Ship's wireless operators should be instructed to report to the Master any interference with a ship's main wireless installation caused by a broadcast receiver on board. It is within the competence of the Master to prohibit the use of wireless apparatus by passengers or crew, if he considers it is desirable to do so.

(2) *For ships not equipped with wireless installations*

Broadcast Receiver licences for such ships registered in British India can be issued to individual officers or members of the crew. Any member of a ship's

company desiring such a licence should apply in the first instance to the Director-General of Posts and Telegraphs, New Delhi giving the name of the ship and forwarding the written consent of the shipowners to the use of the apparatus.

The Director-General is not authorised to issue licences for the erection of wireless Telegraphs on board ships registered in countries other than British India and applicants from such foreign vessels should apply for a licence to the administration to which the ship is subject.

COMMERCIAL LICENCES

Commercial Broadcast Receiver Licences for a fee of Rs 25 are available for a peoird of 12 months from the frist day of the month of issue for the use of one receiver and one loudspeaker with an additional Rs. 10/- for each additional receiver or loudspeaker, covering the reproduction of broadcast programmes for gain or in the public rooms of hotels, restaurants, shops, dance halls and the rooms of any business premises to which the public have access. These licences cover the reproduction at the address specified on the licence and at no other place, and are issued by all Heads of Postal Circles. The address as specified on the licence may be amended by issuing officer on return of the licence together with a written application to this effect. The licensee conveys no permission in respect of infringement of copyright in the matter reproduced.

Provided application for renewal of a Commercial Broadcast Receiver Licence is made before the date of expiry of the licence and the fee and expiring licence are forwarded at the same time, the renewal fee will be Rs. 5 less than that paid for the original licence i. e. Rs. 20 for the use of one receiver and one loudspeaker, Rs. 30 for one receiver and two loudspeakers etc.

CHAPTER XVIII

CHECK UP THE RADIO

Often times it so happens that our radio stops working, due to some very minor trouble, the removal of which does neither require any specialised knowledge nor any equipment. Such faults can be removed by ourselves.

Let us imagine that some such minor fault develops in our radio set and we take it to a workshop. After examination the engineer tells us that there is nothing wrong and the radio is playing quite satisfactorily. When we hear the engineer's report, we feel nonplussed and cannot figure out how this could happen. All the bother of finding out time to take the radio to the service shop and the good amount of money spent on to-and-fro conveyance could have been saved if we only knew how to give an easy check-up to our radio.

Therefore, before we finally remove our radio to a workshop it will be worth while to check up the following points:

1 MAINS PLUG

All radios, except battery operated, have a mains cord with a mains plug having two pins. This plug is inserted in the wall-socket provided in the house wiring. To the two mains wires

from the set, the mains plug is attached, either by means of two screws or by pressure contact. On switching on the radio, if the dial lamps do not light, we have to check up two things in the following manner:

(i) After making sure that the house electric supply has not failed, find out if the wall socket has developed any fault (loose connection etc). This can be done easily by connecting a fan or a table lamp to the suspected socket. If the fan or table lamp works on this socket, it shows that there is nothing wrong with the wall socket ? If neither the fan nor the lamp works; the trouble lies in the socket itself. Get an electrician to put it right.

(ii) After establishing that the wall-socket is not at fault and the electric current in the house has not failed, the next possible fault will be in the mains plug of the radio. If the plug is opened it will be found that one of the mains wires is loose or dangling about in the plug. The wire should be put back to its proper place and secured tightly.

Generally there are two types of plugs. One type can be opened by unscrewing the plug itself whereas the other variety can be opened by taking out the two fixing screws by means of a small screw driver.

It will be found that in some cases the radio will work even if the dial lamps do not light, showing thereby that only the dial lamps (or lamp) have failed.

2 VALVES

Mounting of the valves has to be checked on certain occasions. When we have to carry our radio set from one town to the other, in a train or a motor lorry, the valves either come out of their sockets due to vibrations or become loose in the sockets. In such cases the dial lamps may light but the radio will refuse to give any programme. The back-cover (many radios do not have this) should be taken out and after all the valves are gently pressed, we will find the radio behaving normally when switched on. It is, however, very important to note that before opening the back-cover and touching any part inside the radio, we should make sure that the mains plug of the radio has been taken out of the house wall socket; otherwise we definitely run the risk of getting an electric shock which may prove fatal.

3 TRANSMITTER BREAK-DOWN

The possibilities of breakdown in the transmitting station cannot be ruled out altogether. Such occasions are rare but all the same they do come up. And when such a breakdown in a transmitter occurs, we cannot get that particular

station on our radio ; leading us to believe that some thing has gone amiss in our radio. In such cases it is advisable to try some other stations on the same wave band ; and if other stations are heard it is more or less an indication of a breakdown in that particular transmitter. On medium wave band (200 to 500 Meters) this simple test may not be possible in day time, since other stations on this band, except the local, cannot be received during the day time. However, if the pointer is moved from end to end of the dial scale, observing all the while if the noise due to atmospheric and electrical disturbances is audible on this band. If the noise is audible, it means that there is a breakdown in that particular transmitter ; otherwise when no noise is heard any where on this band, then we can reasonably be sure that the radio set has failed. The radio may have developed some fault in this particular wave band or on all the other wave bands.

Even after checking as above, if we still persist, due to over-precautionary habits, in believing that some thing is wrong with the radio, it is not advisable to rush the radio to a workshop until we have tried the same station again at some other time the same day or the next day or have contacted our neighbours or have phoned up our usual radio workshop people for information on this point.

The author of this book has come across several such cases when the customers had taken their radios to the workshop only to be informed that there was a break in the transmitting service. In one case, the customer resided at a place about forty miles from Bombay. He was listening to local morning broadcast (Bombay on 244 meters) on his brand new set. After listening for about an hour, the programme suddenly stopped. The customer, without any second thought, rushed to the workshop with the radio. The set was tried in the workshop and the customer had to be told about the breakdown in the 244 meter transmitter of Bombay Station. Just imagine the troubles this customer had to undergo—and all that unnecessarily !

4 CHANGES IN WAVELENGTHS

The All India Radio Stations very frequently change the transmission wavelengths. This they have to do, bearing in mind the sun-spot activity which favours particular transmission frequencies in particular seasons. Bombay, Delhi, Madras, and Calcutta short wave transmitters broadcast either on 41, 49, 60, or 90 meter bands during different seasons. If a particular station is not heard on a particular band, we must make sure by reference to some newspapers or Indian Listener or by consulting friends or the radio workshop, that this

particular station has not changed the transmission from one frequency to the other.

5 FAULTY AERIALS

Complaints about faulty or no short wave reception are varied and many. A set situated near a local station receives the local station to the satisfaction of the listener even if the aerial is totally or partially faulty ; but when an attempt is made to receive any other station he has to face disappointment, resulting in rebukes to the radio service agency where the set was last repaired. The rebukes are calmly listened to by the man in charge of the workshop and working on the famous maxim 'CUSTOMERS ARE ALWAYS RIGHT', the engineer humbly points out the possibilities of the faults in the aerial. The engineer has then to stand a further volley of rebukes from the listener. The listener is then advised to send the radio back to the workshop for a check-up. The listener takes the radio to the workshop only to find that the radio receives all stations perfectly on the workshop aerial which is no better than other aerials installed else where. The listener then realises the folly of his arguments, apologises and requests the engineer to send out the aerial-mechanic to check-up the aerial and do the needful.

So that something very similar as above may not happen to us, we should, before throwing the

blame on the radio service people, check up our aerial. A normal aerial should not touch ground or earth. This means that any bare portion (without insulation) of the aerial wire should not touch walls, trees, pipes etc. There should be no break in the aerial. If we are not able to find this out for ourselves, we should get the workshop people to check it up.

6 AERIAL-EARTH TERMINALS

Many a time it so happens that by connecting the aerial to wrong terminal we do not get proper reception. The general convention is that the wire to which is attached a RED plug is the aerial wire and the wire having a BLACK plug is the earth wire. Similarly, the terminals on the radio set too are marked A for aerial and E or G for earth. Some radios have imprints such as ANTENNA or AERIAL to mark the aerial terminal. Some radio firms put a knot on the aerial wire and leave the earth wire without any such knot. The aerial and earth wire should be connected to proper terminals otherwise reception will suffer or the set may get damaged. Particularly the AC/DC sets are more prone to such damage.

7 RADIO-GRAMO SWITCH

Several radios are provided with a switch by operating which we can either get gramophone record music from our pick-up or the radio

reception. Some times we (the children also play about with this) leave this switch on GRAM position and try to tune the radio to some station. With Radio-Gramo switch on GRAM position we cannot expect any radio programme on the set; because the switch has temporarily disconnected that portion of the inner wiring which was essential for radio reception. Similarly, if the switch is on RADIO position we cannot get 'record music' from our pick-up even though we may see the record running, and the pick-up racing on the record.

If these seven precautions are taken before finally removing the set to a workshop, it will be found that not only time but money too will have been saved on many occasions.

CHAPTER XIX

SHORT WAVE STATIONS
OF
THE WORLD

There are hundreds of broadcasting stations in the world that have adopted short waves as their "Carrier". And, therefore, such stations are called "Short Wave Stations". The greatest advantage that we learnt about short waves is that long distance transmission and subsequent reception is possible with short waves. But there are certain factors that govern the long distance reception to a considerable extent. Firstly, the power of the station is a very important consideration. If the power of the station is 2 or 3 K. W. the radiated signals from this station may not be strong enough to be picked up by a receiver that is thousands of miles away from the transmitter. This is the main reason why our Delhi Station is now having a 100 K. W. Transmitter to contact the entire world. The power of 10 K. W. used by one of the Delhi Short Wave Stations proved inadequate for direct world broadcasts. Secondly, the factor 'Beam Transmission' comes in. In Chapter IX on page 92, we have learnt that reflectors can be used on short waves enabling the radiation only in one desired direction. Transmission that is made to

radiate the larger part of the energy in one direction by means of reflectors, is known as Beam Transmission or Directional Transmission. Mostly all European stations resort to this type of transmissions, and therefore receiving centres that are out of the beam range may not receive at all or receive very faintly such transmissions. The main idea underlying these beam transmissions is to cover longer distances in one particular direction and not shorter distances in all directions. Japan, England, Peru, Hungary, Jugoslavia, Manchuko, Sweeden, Russia rely very much on such' Beam Service.' England alone works about a dozen transmitters simultaneously but each one of them is directed to a particular part of the world. The transmission directed towards U. S. A. will be of no practical use to India and vice versa. Thirdly, the "Skip Effect" has to be taken into consideration. In chapter IX, we have seen that the energy from the transmitter is radiated by two ways. One is due to the 'sky wave and the other is due to the 'ground wave'. And as has been said before, since the ground wave dies out after some distance from the transmitter, due to ionisation, there remains only the "sky wave" or "space wave" which is reflected back to earth by the Kennelly-Heaviside layer. The distance between the point where the ground wave dies out and the point where first reception is obtained due to reflection from Kennelly—Heaviside layer is known as "Skip Distance". Therefore if a receiver is situated in a place which falls within the skip distance of a particular transmitter, the

receiver will not pick up transmissions of that transmitter, no matter how best the radio is. Due to effects of skip distance, the 13 meter and 16 meter broadcasts from London which are so well received in India are reported not to be received in Paris. The skip distance effect is shown diagramatically in Fig. 1.

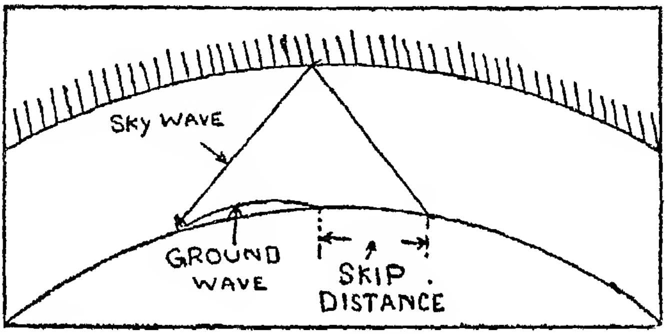


FIG. 1

Therefore, while attempting to tune in short wave stations these three points have to be borne in mind always. There are two types of lists of short wave stations given on the next few pages. One contains the names of stations of different countries with the approximate timings to receive them, whereas the other gives short wave stations without timings, but covering larger number of stations. Both these lists indicate pre-war conditions. However, corrections have been made wherever new data was available. Mostly all the German and some of the Italian stations listed are not on the air yet.

CHINA

Call Sign	CITY	Frequency in Megacycles	Metres	Approx. Timing for Reception
ZBW5	Hongkong	17.7	16.9	9-30 to 11 a.m.
XGOY	Chungking	7.95	41.0	6 to 8-30 p. m.
XOY	Chengtu	9.3	32.2	7 and 8 p. m.

ENGLAND

GRZ	London	21.64	13.86	Irregular
GST	,,	21.55	13.92	,,
GSI	,,	21.53	13.93	4 to 8 p m.
GSV	,,	17.81	16.84	3-45 to 7 p.m.
GSI	,,	15.26	19.66	10 to 12-0 a.m.
GSO	,,	15.18	19 76	7 to 10 p.m.
GSE	,,	11.86	25.3	7-40 p.m.
GSD	,,	11.75	25.5	2 to 4 a.m. 7-25 and 9 a.m.
GRX	,,	9.69	30 96	4 to 8-15 p m.

ENGLAND—*Contd.*

Call Sign	CITY	Frequency in Mega-cycles	Metres	Approx. Timing for Reception
GRY	London	9.6	31.25	10 p.m. 4 a m.
GSC	,,	9.38	31.32	10-20 p.m. 2 a.m. 4 a m. 7-20 a.m. and 9 15 a.m.
GSA	,,	6.05	49.59	4-30 p.m. 4-0 a.m.
GSA	,,	21.4	13	2 p.m.

FRANCE

TPB 3	Paris	17.85	16.8	3 p.m.—8 p.m.
TPA 2	,,	15.23	19.6	3 to 8-30 p m.
TPB 6	,,	15.13	19.83	Irregular
TPB 11	,,	11.885	25.24	Not known
TPB 12	,,	11.88	25.24	,, ,,
TPB 12	,,	7.2	41.21	3-15 a.m., 6-30 a.m.

GERMANY

Call Sign	CITY	Frequency in Megacycles	Metres	Approx. Timing for Reception
DJH	Berlin	17.84	16.81	10-15 a. m. 5-50 p. m. 7-15 to 9 p.m.
DJE	,,	17.76	16.89	2-50 a.m 7a.m.
DJR	,,	15.34	19.56	2-15 to 8-45 a. m.
DJQ	,,	15 28	19.63	10 a.m. 9 p.m.
DJB	,,	15.20	19.74	10-5 a.m. 8-45 a.m. 9-5 p.m.
DJP	,,	11.85	25.31	Irregular
DJD	,,	11.77	25.49	2-30 to 8-45 a.m.
DZC	Zessen	10.55	29.16	Irregular
DJA	Berlin	9.56	31.38	4-30 a.m. 8-45 a.m. 9-30 p m.
DJN	,,	9.54	31.45	Not known
DJM	,,	6.07	49.34	Irregular

HOLLAND

Call Sign	CITY	Frequency in Megacycles	Metres	Approx. Timing for Reception
PH 12	Huizen	17.77	16.88	5 to 10 p.m. Irregular
PCJ 2	,,	15.22	19.71	Irregular
PHI	,,	11.73	25.57	Not known
PCJ	,,	9 59	31.28	Irregular

ITALY

2 RO 16	Rome	21.51	13 94	8 to 9 p m.
2 RO 8	,,	17.82	16.84	3p.m. 6-50p.m.
2 RO 6	,,	15.3	19.61	8p.m. Irregular
2 RO 4	,,	11.81	25 4	Not known
IQY	,,	11.67	25.7	10 to 7 p.m. 12-30 a.m. 4 to 7 a m.
IRF	,,	9.83	30.52	10p.m. to 1a.m. 4 to 7 a.m.
2 RO 9	,,	9.66	31.4	10 to 12 m.n. 2-30to4-30a.m.

JAPAN

Call Sign	CITY	Frequency in Mega-cycles	Metres	Approx. Timing for Reception
JZL	Tokyo	17.78	16.86	2-15 a m. 3-15 a.m.
JZK	,,	15.16	19.79	5 to 8 p.m.
JLU3	,,	15.13	19.82	6 to 7-30 p m.
JZJ	,,	11.8	25.42	5-30 p.m. 7-45 p m.
JZH	,,	6.9	49.2	Irregular

JAVA

YDD	Bandoeng	6.06	49.5	3-30 to 6-30 p m.
YDC	,,	15.15	19.8	3 to 8 p m.

RUSSIA

RV96	Moscow	15.18	19 76	1 to 4 a.m.
RKI	,,	15.08	19 95	5 a.m. 7 p.m.

RUSSIA—*Contd.*

Call Sign	CITY	Frequency in Mega-cycles	Metres	Approx. Timing for Reception
RNE	Moscow	12.00	25.00	11 p.m. 1 a.m. 3a.m. 6-15a.m.
RAN	,,	9.6	31.25	4 to 8-30 a.m.
RW96	,,	6.03	49.75	11 p m. to l a.m. 2 to 5 a m.

SIAM

HS6PJ	Bangkok	19.0	15.7	6 to 8 p.m. Monday
HS8PJ	,,	9.51	31.55	6 to 8 p.m.

SPAIN

EAQ	Madrid	9.85	30.45	5-30 to 7 a m.

SWITZERLAND

HBL	Geneva	9.3	32.11	5 to 6 a.m. Sometimes Irregular

SWITZERLAND—*Contd.*

Call Sign	CITY	Frequency in Mega-cycles	Metres	Approx. Timing for Reception
HBO	Geneva	11.40	26.31	Not known
HBJ	„	14.53	20.64	Irregular
HBH	„	18.48	16.23	9-30 p.m.

TURKEY

TAQ	Ankara	15.19	19.7	Not known
TAP	„	9.46	31.7	9-30 p.m. to 3 a.m.

U .S. A.

WGEA	Schenectady	21.5	13.95	5 to 8 p.m.
W2XE	N. Y. City	21.57	13.91	Irregular
W2XE	„	17.83	16.83	6-15p m. 11-15 a.m. 8 p.m.
W2XE	„	15.27	19.65	8 to 10 p.m. 3-0 a.m.

U. S. A.—*Contd.*

Call Sign	CITY	Frequency in Mega-cycles	Metres	Approx. Timing for Reception
WSLA	Boston	15.25	19.67	1 to 2 a.m.
W2XE	N. Y. City	11.83	25.36	7 to 9-45 a.m.
W2XE	,,	9.6	31.09	Irregular
WGEA	Schenectady	9.55	31.41	4 a.m. 7 a.m.
KGEI	San Francisco	9.53	31.48	10 a.m. 10 p.m.
WSLA	Boston	6.04	49.6	5 to 7 a.m. 12-30 a.m. 4 a.m.

Country	City	Call	Band Metres	Freq'cy KC.
Albania	Tirana	ZAA	49	6085
Argentina	Buenos Aires	LRA2	49	6180
Argentina	Buenos Aires	LRX	31	9660
Argentina	Buenos Aires	LRU	19	15290
Australia	Melbourne	VLR	31	9580
Australia	Melbourne	VLR3	25	11850
Australia	Perth	VLW2	31	9645
Australia	Perth	VLW3	25	11830
Australia	Sydney	VLQ	31	9615
Australia	Sydney	VLQ5	31	9680
Australia	Sydney	VLQ2	25	11870
Bahamas	Nassau	ZNS2	49	6090
Bolivia	La Paz	CP5	49	6200
Brazil	Rio de Janeiro	PRF5	25	11855
Brit. Guiana	Georgetown	VP3BG	49	6130

Country	City	Call	Band Metres	Freq'cy KC.
B. Honduras	Belize	ZIK2	28	10600
Burma	Rangoon	XYZ	49	6007
Canada	Halifax	CHNX	49	6132
Canada	Montreal	CFCX	49	6010
Canada	Sydney	CJCX	49	6010
Canada	Toronto	CFRX	49	6070
Canada	Winnipeg	CJRO	49	6150
Canada	Winnipeg	CJRX	25	11720
Chile	Santiago	CB960	31	9600
Chile	Santiago	CB1170	25	11700
Chile	Santiago	CB1174	25	11740
Chile	Santiago	CB1180	25	11945
Chile	Valdivia	CD1190	25	11910
Chile	Valparaiso	CB970	31	9730
China	Canton	XGOK	25	11650

Country	City	Call	Band Meters	Frcq'cy KC.
China	Szechwan	XGOY	31	9640
China	Szechwan	XGOY	25	11895
China	Szechwan	XGOX	19	15190
Colombia	Armenia	HJ6FAH	60	4875
Colombia	Barranquilla	HJAB	60	4785
Colombia	Barranquilla	HJAG	60	4905
Colombia	Bogota	HJCH	60	4895
Colombia	Bogota	HJCW	60	4945
Colombia	Bogota	HJCX	49	6018
Colombia	Bogota	HJCD	49	6160
Colombia	Bogota	HJCT	31	9630
Colombia	Bogota	HJCF	31	9710
Colombia	Bucaramanga	HJGB	60	4775
Colombia	Buenaventura	HJEH	60	4755
Colombia	Cali	HJED	90	4825

Country	City	Call	Band Metres	Freq'cy KC.
Colombia	Cartagena	HJAE	60	4835
Colombia	Cartagena	HJAP	60	4925
Colombia	Cucuta	HJBB	60	4815
Colombia	Manizales	HJFB	49	6105
Colombia	Medellin	HJDX	60	4795
Colombia	Medellin	HJDP	60	4885
Colombia	Medellin	HJDE	49	6145
Colombia	Pereira	HJFK	60	4865
Colombia	Pereira	HJFA	49	6054
Colombia	Pereira	HJFK	31	9730
Colombia	Quibdo	HJDG	60	4805
Costa Rica	San Jose	TILS	49	6165
Costa Rica	San Jose	TIRCC	49	6185
Costa Rica	San Jose	TIPG	31	9620
Cuba	Havana	COCD	49	6132

Country	City	Call	Band Metres	Freq.cy KC.
Cuba	Havana	COCH	31	9440
Cuba	Matanzas	COGF	25	11800
Denmark	Copenhagen	OZF	31	9520
Denmark	Copenhagen	OZH	19	15320
Dom'can Rep.	La Romana .	H13C	49	6150
Dom'can Rep	S.F.de Macoris	H14V	49	6175
Dom'can Rep.	Santiago	H11A	49	6190
Dom'can Rep.	Trujillo City	H16H	49	6112
Dom'can Rep.	Trujillo City	H12D	49	6195
Ecuador	Guayaquil	HCODA	41	9445
England	London	GSA	49	6050
England	London	GSW	41	7230
England	London	GSB	31	9510
England	London	GSC	31	9580
England	London	GSD	25	11750

Country	City	Call	Band Metres	Freq'cy KC.
England	London	GSE	25	11860
England	London	GSF	19	15140
England	London	GSI	19	15260
England	London	GSP	19	15310
England	London	GSG	16	17790
England	London	GSV	16	17810
England	London	GSH	13	21470
England	London	GSJ	13	21530
England	London	GST	13	21550
Finland	Lahti	OFD	31	9500
Finland	Lahti	OIE	19	15190
France	Paris	TPB25	41	7280
France	Paris	TPC	31	9520
France	Paris	TPC 23	31	9680
France	Paris	TPA4	25	11718

Country	City	Call	Band Metres	Freq'cy KC
France	Paris	TPC8	25	11845
France	Paris	TPB7	25	11880
France	Paris	TPA3	25	11885
France	Paris	TPB6	19	15130
France	Paris	TPA2	19	15240
France	Paris	TPB4	19	15295
France	Paris	TPB3	16	17765
Fr.Indo-China	Saigon	—	25	11780
Fiji's	Suva	VPD2	31	9535
Germany	Berlin	DJC	49	6020
Germany	Berlin	DJA	31	9560
Germany	Berlin	DXB	31	9610
Germany	Berlin	DJW	31	9650
Germany	Berlin	DJD	25	11770
Germany	Berlin	DJL	19	15110

Country	City	Call	Band Metres	Freq'cy KC
Germany	Berlin	DJB	19	15200
Germany	Berlin	DXT	19	15230
Germany	Berlin	DJQ	19	15280
Germany	Berlin	DJR	19	15340
Germany	Berlin	DJE	16	17760
Germany	Berlin	DJH	16	17845
Guadeloupe	Pointe-a-Pitre	FG8AH	41	7445
Guatemala	G. City	TG2	49	6200
Guatemala	G. City	TGWB	49	6465
Guatemala	G. City	TGWA	31	9685
Guatemala	G. City	TGWA	19	15170
Hong Kong	Hong Kong	ZBW3	31	9525
Hungary	Budapest	HAT5	31	9625
Hungary	Budapest	HAD3	25	11850
India	Bombay	VUB2	60	4880

Country	City	Call	Band Metres	Freq'cy KC.
India	Bombay	VUB2	90	3365
India	Bombay	VUB2	31	9550
India	Bombay	VUB2	41	7445
India	Calcutta	VUC2	60	4840
India	Calcutta	VUC2	90	3305
India	Calcutta	VUC2	31	9528
India	Delhi	VUD3	16	17850
India	Delhi	VUD2	60	4960
India	Delhi	VUD2	90	3495
India	Delhi	VUD2	31	9590
India	Delhi	VUD2	41	7290
India	Delhi	VUD3	19	15290
India	Delhi	VUD3	49	6010
India	Madras	VUM2	60	4920
India	Madras	VUM2	90	3435

Country	City	Call	Band Metres	Freq'cy KC.
India	Madras	VUM2	25	11873
Ireland	Athlone	EIRE	31	9595
Italy	Rome	2RO11	41	7000
Italy	Rome	2RO3	31	9630
Italy	Rome	2RO9	31	9667
Italy	Rome	2RO15	25	11760
Italy	Rome	2RO4	25	11810
Italy	Rome	2RO6	19	15300
Italy	Rome	2RO20	16	17770
Italy	Rome	2RO8	16	17820
Jamaica	Kingston	ZQ1	60	4750
Japan	Tokio	JVW	41	7257
Japan	Tokio	JZI	31	9535
Japan	Tokio	JVW3	25	11725
Japan	Tokio	JZJ	25	11795

Country	City	Call	Band Metres	Freq'cy KC.
Japan	Tokio	JZK	19	15160
Jugoslavia	Belgrade	YUD	31	9505
Jugoslavia	Belgrade	YUE	25	11735
Jugoslavia	Belgrade	YUF	19	15240
Jugoslavia	Belgrade	YUG	19	15240
Java	Bandoeng	YDC	19	15150
Madagascar	Tananarive		49	6063
Manchukuo	Hsinking	MTCY	25	11775
Mexico	Mexico, D. F.	XEBT	49	6005
Mexico	Mexico, D. F.	XEUZ	49	6117
Mexico	Mexico, D. F.	XEXA	49	6180
Mexico	Mexico, D. F.	XECR	41	7380
Mexico	Mexico, D. F.	XEWW	31	9503
Mexico	Mexico, D. F.	XEQQ	31	9680
Mexico	Monterey	XETA	31	9555

Country	City	Call	Band Metres	Freq'cy KC.
Mexico	Veracruz	XEUW	49	6023
Mozambique	Lourenco Marques	CR7AA	49	6137
Mozambique	Lourenco Marques	CR7BE	31	9650
Mozambique	Lourenco Marques	CR7BD	19	15240
Mozambique	Lourenco Marques	CR7BG	19	15285
Netherlands (Holland)	Huizen	PCJ	31	9590
Netherlands	Huizen	PCJ2	19	15220
Netherlands	Huizen	PHI2	16	17770
Newfoundland	St. John's	VONG	49	5973
Newfoundland	St. John's	VONG	31	9480
Norway	Oslo	LKV	19	15170
Panama	Colon	HP5K	49	6005
Panama	Colon	HP5F	49	6050
Panama	Panama City	HP5B	49	6033

Country	City	Call	Band Meters	Freq'cy KC.
Panama	Panama City	HP5H	49	6122
Panama	Panama City	HP5J	31	9607
Panama	Panama City	HP5A	25	11700
Panama	Panama City	HP5G	25	11785
Paraguay	Villarica	ZP14	25	11720
Peru	Ica	OAX5C	31	9430
Peru	Lima	OAX4Z	49	6080
Peru	Lima	OAX4T	31	9562
Peru	Lima	OAX4R	19	15150
Philippines	Manila	KZIB	49	6040
Philippines	Manila	KZRH	49	6100
Philippines	Manila	KZRF	49	6140
Philippines	Manila	KZIB	31	9492
Philippines	Manila	KZRM	31	9570
Philippines	Manila	KZRH	31	9635

Country	City	Call	Band Metres	Freq'cy KC.
South Africa	Capetown	ZRK	49	6097
South Africa	Capetown	ZRL	31	9615
South Africa	Durban	ZTD	49	6147
South Africa	Durban	ZTE	25	11770
South Africa	Johannesburg	ZRH	49	6007
South Africa	Johannesburg	ZRJ	49	6097
South Africa	Johannesburg	ZRG	31	9520
Spain	Malaga	EAJ9	41	7220
StraitsSettlm't	Penang	ZHJ	49	6094
Sweden	Motala	SBO	49	6065
Sweden	Motala	SBU	31	9535
Sweden	Motala	SBP	25	11705
Sweden	Motala	SBT	19	15155
Switzerland	Geneva	HBL	31	9345
Taiwan	Taihoku	JFO	31	9630

Country	City	Call	Band Metres	Freq'cy KC.
Taiwan	Tyureki	JIE	41	7295
Turkey	Ankara	TAP	31	9465
Turkey	Ankara	TAQ	19	15195
United States	Boston, Mass,	WBOS	31	9570
United States	Boston, Mass,	WRUL	49	6040
United States	Boston, Mass,	WRUW	25	11730
United States	Boston, Mass,	WRUL	25	11730
United States	Boston, Mass	WRUL	25	11790
United States	Boston, Mass	WRUW	25	11790
United States	Boston, Mass	WRUW	19	15130
United States	Boston, Mass	WRUL	19	15130
United States	Boston, Mass	WRUL	19	15250
United States	Boston, Mass	WRUW	19	15250
United States	Cincinnati,Ohio	WLWO	49	6060
United States	Cincinnati,Ohio	W8XNU	11	25950

Country	City	Call	Band Metres	Freq'cy KC.
United States	Dallas, Texas	W5XD	11	25300
United States	Denver, Colo.	W9XLA	11	25400
United States	Kansas City, Mo.	W9XA	11	26000
United States	Miami, Fla.	WDJM	49	6040
United States	Nashville, Tenn.	W4XA	11	26150
United States	NewYork, N.Y.	WNBI	49	6100
United States	NewYork, N.Y.	WCBX	49	6120
United States	NewYork, N.Y.	WCBX	31	9650
United States	NewYork, N.Y.	WRCA	31	9670
United States	NewYork, N.Y.	WCBX	25	11830
United States	NewYork, N.Y.	WNBI	16	17780
United States	NewYork, N.Y.	WCBX	16	17830
United States	NewYork, N.Y.	WRCA	13	21630
United States	Okla. City, Okla.	W5XAU	11	26135
United States	Philadelphia, Pa	WCAB	49	6060

Country	City	Call	Band Metres	Freq'cy KC.
United States	Philadelphia, Pa.	WCAB	31	9590
United States	Philadelphia, Pa.	WCAB	19	15270
United States	Pittsburgh, Pa.	WPIT	49	6140
United States	Pittsburgh, Pa.	WPIT	25	11870
United States	Pittsburgh, Pa.	WPIT	19	15210
United States	Pittsburgh, Pa.	WPIT	13	21540
United States	South Bend, Ind.	W9XH	11	26050
United States	St. Louis, Mo.	W9XPD	11	25900
United States	San Fr'nc'co, Cal.	KGEI	31	9530
United States	San Fr'nc'co, Cal.	KGEI	19	15330
United States	Sch'n'ct'dy, N.Y.	WGEO	31	9530
United States	Sch'n'ct'dy, N.Y.	WGEA	31	9550
United States	Sch'n'ct'dy, N.Y.	WGEA	19	11330
United States	Sch'n'ct'dy, N.Y.	WGEA	13	21500
U. S. S. R.	Moscow	RV96	49	6030

Country	City	Call	Band Metres	Freq'cy KC.
U. S. S. R.	Moscow	RV96	31	9520
U. S. S. R.	Moscow	RAN	31	9600
U. S. S. R.	Moscow	RV96	31	9685
U. S. S. R.	Moscow	RIF	25	11895
U. S. S. R.	Moscow	RNE	25	12000
U. S. S. R.	Moscow	RKI	19	15040
U. S. S. R.	Moscow	RV96	19	15180
U. S. S. R.	Moscow	RV96	19	15410
Uruguay	Colonia	CXA8	31	9640
Uruguay	Colonia	CXA14	25	11825
Uruguay	Montevideo	CXA2	31	9570
Uruguay	Montevideo	CXA6	31	9625
Vatican City	Vatican City	HVJ	49	6190
Vatican City	Vatican City	HVJ	31	9660
Vatican City	Vatican City	HVJ	25	11740

Country	City	Call	Band Metres	Freq'cy KC.
Vatican City	Vatican City	HVJ	19	15120
Venezuela	Barquisimeto	YV3RN	60	4820
Venezuela	Barquisimeto	YV3RX	60	4990
Venezuela	Bolivar	YV6RU	60	4880
Venezuela	Bolivar	YV6RT	60	4900
Venezuela	Caracas	YV5RY	60	4788
Venezuela	Caracas	YV5RU	60	4830
Venezuela	Caracas	YV5RH	60	4920
Venezuela	Caracas	YV5RO	60	4940
Venezuela	Caracas	YV5RS	60	4960
Venezuela	Caracas	YV5RM	60	5010
Venezuela	Caracas	YV5RN	60	5035
Venezuela	Coro	YV1RY	60	4910
Venezuela	Coro	YV1RJ	60	4975
Venezuela	Maracaibo	YV1RT	60	4765

Country	City	Call	Band Metres	Freq'cy KC.
Venezuela	Maracaibo	YV1RV	60	4798
Venezuela	Maracaibo	YV1RU	60	4810
Venezuela	Maracaibo	YV1RL	60	4860
Venezuela	Maracaibo	YV1RX	60	4890
Venezuela	Maracay	YV4RX	60	4840
Venezuela	Puerto Cabello	YV4RQ	60	5020
Venezuela	San Cristobal	YV2RN	60	4870
Venezuela	Trujillo	YV1RO	60	4778
Venezuela	Valencia	YV4RP	60	4930
Venezuela	Valencia	YV4RO	60	4953
Venezuela	Valera	YV1RZ	60	4850

CHAPTER XX

DEVELOPMENT OF BROADCASTING IN INDIA

Broadcasting in India owes its beginning to private enterprise. In the earlies of the year 1927 a company known as Indian Broadcasting Company Ltd. was formed to start and develop the broadcasting in this country. This company inaugurated the Bombay station on the 23rd July 1927. Prior to this company coming in existance, a number of amateurs and associations had been permitted to broadcast on very low-powered transmitters in various parts of this country. Till the year 1926 nobody seriously thought of regular broadcasting service; but in the beginning of 1927 the idea of regular service materialised due to an agreement that was drawn up between the Government of India and the newly formed Indian Broadcasting Co. Ltd., under which the latter was granted a licence by the former, for the construction of two stations at Bombay and Calcutta. 23rd July 1927 saw the inauguration of Bombay station and the Calcutta station was opened on the 26th August 1927. Both these stations have a low power of 1.5 K.W. and their effective receiving range about 30 miles.

The number of listeners then was little below one thousand but by the end of the year 1927 the figure

End of the year	Number of licences
1926	Less than 1000
1927	3600
1928	6000
1929	7700
1930	7720
1931	7750
1932	8550
1933	10,850
1934	16,200
1935	25,000
1936	50,000
1937	60,000
1938	64,000
1939	92,782
1940	119,417

End of the year	Number of licences
1941	147,121
1942	165,675
1943	176,061
1944	193,515
1945	202,829
1946	232,368
End of May 1947	250,355

rose to about 3600 and the end of the year 1928 saw a total of 6000 licences issued to listeners. The table above gives a rough idea about how the number of listeners kept on changing from time to time.

It will be observed that during the years 1932 to 1934 the increase in the number of licences is very rapid i.e., from 8000 in 1932 it has jumped to 16000. This sudden increase can be rightly attributed to the inauguration of British Broadcasting Corporation's Empire Service on 19th December 1932. This service induced the european community in India to become radio-minded and thus there had been a heavy demand for licences.

The Indian Broadcasting Company Ltd. had an authorised capital of 15 lakhs out of which shares worth six lakhs were fully paid up. Out of this collected and subscribed revenue of six lakhs the company was required to spend about four and a half lakh on the installation of Bombay and Calcutta Stations. And in those days the annual revenue of the company consisted of 80 per cent. of the licence fee charged by the Government of India at the rate of Rs. 10 per annum per licence and a tribute of 10% of the invoice price of imported wireless accessories which had to be collected by the company itself from the dealers. After the installation and erection of Bombay and Calcutta station the company had only one and a half lakh rupees and it was found out that the monthly expenditure of Rs. 33,000 was very much excessive to be met from the monthly income which had been very poor. Thus the company was required to draw from the capital account. The month by month recurring deficit compelled the management of the company to approach the Government of India for financial help but the latter informed the former in the year 1930, that they could not do anything in the matter. Therefore, under advice of the Board of Directors the company went into liquidation with effect from 1st March 1930.

The news of the liquidation of the company was a shock to the licence-holders who were by now too much radio-minded ; but the radio dealers were to suffer much because of the stocks of wireless apparatus to the value

of many lakhs of rupees. The representations made by the public and radio dealers, coupled with the demand made by Indian Legislatures, resulted in the Government of India taking over broadcasting and continuing it. From 1st April 1930 the service was placed under the direct control of the Government of India in the Department of Industries and Labour under the designation of "The Indian State Broadcasting Service". But after an experience of running this service for about six months Government decided in October 1931 to close down the service. This decision created unprecedented sensation all over India and once more a pressure was brought upon the government by puplic, newspapers and legislatures urging for the continuance of the service. In response to this the Government decided to run the service for an interim period during which Government expected that some private enterprise will come forward to take over the service. But such private enterprise was not to be found, and it was finally decided in May 1932 to continue the service under State Management.

The Indian Telegraphy Act of 1885 had no restrictions on the possession of wireless apparatus. To amend this situation the Indian Wireless Telegraphy Act was passsed in 1933. And to make the service financially more stable, the Government increased the custom duty on wireless goods thereby increasing the income. In 1934 a grant of Rs. 2¼ lakhs was sanctioned for a station at Delhi and full co-operation of British Broadcasting

Corporation was arranged for by the Government. A 20 K. W. transmitter was installed at Delhi and the regular transmissions were started from this station on 1st January 1936.

In November 1935 the B. B. C., London agreed to send out to India, free of charge, Mr. H. L. Kirke, the head of the B. B. C. Research Department. On recommendations of Mr. Kirke, the Government made a provision of Rs. 40 lakhs for the development of broadcasting in India and it was decided to open following stations in addition to the four medium wave transmitters already existing at Bombay, Calcutta, Delhi and Peshawar.

Delhi	10 K. W.	Short Wave
Delhi	5 K. W.	Short Wave
Bombay	10 K. W.	Short Wave
Calcutta	10 K. W.	Short Wave
Madras	0.25 K. W.	Medium Wave
Madras	10 K. W.	Short Wave
Lahore	5 K. W.	Medium Wave
Lucknow	5 K. W.	Medium Wave
Dacca	5 K. W.	Medium Wave
Trichinopoly	5 K. W.	Medium Wave

The equipment for these stations was ordered out in January 1937 by the Government under the advice of Mr. C. W. Goyder—the Chief Engineer of

Braodcasting, and all these stations came into operation on the following dates :—

Lahore	5 K. W.	Medium	16th Dec. 1937
Delhi	10 K. W.	Short	16th Dec. 1937
Bombay	10 K. W.	Short	14th Feb. 1938
Lucknow	5 K. W.	Med.	2nd April 1938
Delhi	5 K. W.	Short	1st June 1938
Madras	10 K. W.	Short	16th June 1938
Madras	0.25 K. W.	Med.	16th June 1938
Calcutta	10 K. W.	Short	16th Aug. 1938

After 16th August 1938, stations at Trichinopoly and Dacca had been installed making a total of nine transmitting stations and fourteen transmitters.

The present official designation of this broadcasting service is ALL INDIA RADIO. This change in designation had been effected from 8th June 1936.

The geography, the culture, the history and her attainments make India's place in the comity of nations quite enviable, and it is no wonder if India felt a necessity of the introduction of radio broadcasts for the entire world. The low powered broadcasting stations were deemed inadequate for this purpose and a high power transmitter of 100 K. W. was installed at Delhi during the war-years. Apart from this welcome addition, the Govt. of India have announced an Eight Year Plan for the development of-broadcasting in India.

The salient features of this plan have been summed up below:

> A five-year plan was drawn up in the first instance for All India Radio but having regard to the wide demands from various interests and the forseeable difficulties in respect of equipment and staff it became apparent that this plan, which is briefly mentioned in the report of the Advisory Planning Board, was not sufficiently balanced. It was accordingly decided to prepare an Eight-year plan, though at the moment only the finances for five years have been taken into account.
>
> In deciding the new stations to be opened in the eight year plan the following considerations have been kept in view:
>
> (*a*) Demand of the linguistic areas hitherto unprovided with a service and the importance of the language from the literary point of view and from the size of the population speaking the language.
>
> (*b*) Demands of the various provinces.
>
> (*c*) Potentiality of the Broadcasting Centre to bring in increased revenue.
>
> (*d*) Availability of programme talent at the centre or within easy reach of the centre.
>
> (*e*) Importance of the centre as an educational and cultural centre.

(*f*) Density of urban and rural population within the service area of the broadcasting centre.

(*g*) Density of villages and hamlets within the service area of the centre which will determine its usefulness as a rural centre.

The main features of the eight-year plan are as follows :

(i) Construction of studio buildings at Madras and Calcutta as well as provision of additional office accomodation and studio facilities at the existing broadcasting centres.

(ii) Installation of EIGHT high-power Medium Wave transmitters for urban programmes ; two each at Bombay, Calcutta, Madras and Delhi.

(iii) Installation of THREE 20 KW Medium-wave transmitters for rural programmes ; one each at Bombay, Calcutta and Madras.

(iv) Installation of TWO high-power and ONE 20KW medium-wave transmitters at Allahabad.

(v) Installation of EIGHT 20KW Medium-wave Transmitters ; one each at Karachi, Nagpur, Bezwada, Ahemedabad, Cuttuck, Dharwar, Gauhati and Calicut.

For the purposes of administrative economy and convenience and also to facilitate planning, five zones have been considered, taking into account linguistic, musical and similar cultural affinities. Delhi, Calcutta, Madras, Bombay and Allahabad for which high-power transmitters have been provided will be treated as zonal centres. The zonal centaes as well as the following new centres will be completed or opened during the first five years of the plan: Nagpur, Cuttuck, Shillong (or Gauhati) and Ahmedabad.

The Eight-year Plan has been duly approved by the Standing Advisory Committeé attached to the Information & Broadcasting Department, Govt. of India. The new transmitters will be installed as and when the necessary equipment and staff become available.

The expenditure is estimated at Rs. 3,57,00,000 non-recurring and Rs. 86,00,000 recurring. The number of licences is expected to rise from 230,000 to about 500,000 after five years.

This Eight-year Plan was announced before the partition of the country. In the aftermath of the communal disorders that followed the Independance day, it was considered advisable by the Govt. of India to have a small broadcasting station at Jullundar situated near the frontier of Indian Union. Accordingly a small station has come into being at Jullundar operating on

1333 KC or 225 metres, from November 1947. Another station at Patna is being opened very shortly. Nagpur too is making a headway and it is understood that preliminary survey etc. has been already completed at Nagpur.

Apart from the activities of the Government of India in the matters of broadcasting, several Indian States have evinced a great interest in the same. The following particulars will be found interesting.

Name of Station	*Power*	*Freq. in KC*	*Wavelength (In Metres)*
BARODA	5 KW	1200 K/cs	250.00
MYSORE (Akaswani)	5 KW	6065 K/cs	49.46
MYSORE	—	968 K/cs	310.00
TRAVANCORE (Trivendrum)	5 KW	658 K/cs	445.90
HYDERABAD (State)	5 KW	730 K/cs	411.00
AURANGABAD (Hyderabad State)	0.5	940 K/cs	319.00

Besides the above states, Gwalior and Indore are contemplating to have their own Stations in the very near future.

The Agricultural Institute, Allahabad too has an experimental station working on 204.8 Metres and 00 Watts power.

MEDIUM WAVE STATIONS IN INDIAN UNION

	Station	*Frequency (In Kilocycles)*	*Wavelength (In Metres)*
1	DELHI	886.0	338.6
2	BOMBAY	1231.0	244.0
3	CALCUTTA	810.0	370.0
4	MADRAS	1420.0	211.0
5	LUCKNOW	1022.0	293.5
6	TRICHINOPOLY	758.0	395.8
7	JULLUNDAR	1333.0	225.0
8	PATNA	1131.0	265.3
9	CUTTUCK	1355.0	221.4

MEDIUM WAVE STATIONS IN PAKISTAN

1	LAHORE	1086.0	276.0
2	DACCA	1167.0	257.1
3	PESHAWAR	1500.0	200.0
4	PESHAWAR	629.0	476.9
5	KARACHI	To be shortly opened	

MEDIUM WAVE STATIONS IN INDIAN STATES

1	BARODA	1200.0	250.0
2	MYSORE (Akaswani)	968.0	310.0
3	HYDERABAD (Dn)	730.0	411.0
4	AURANGABAD (Hyderabad)	940.0	319.0
5	KASHMIR	To be shortly opened	
6	TRAVANCORE (Trivendrum)	658.0	445.9

THE GENERAL OVERSEAS SERVICE
OF
B. B. C., LONDON

This programme of Entertainment, News and Informatioı is broadcast continuously throughout the day and night. It i: specially directed towards India, Burma and Ceylon on thε following wavelengths :—

6–30 a. m.—9–30 a. m.	48.78 metres, 25.53 metres 31.55 metres
9–30 a. m.—10–30 a. m.	25.53 metres
10–30 a. m.—11–30 a. m.	16.86 metres, 25.53 metres
3–30 p. m.— 7–15 p. m.	13.93 metres, 16.86 metres
7–15 p. m.— 7–30 p. m.	16.86 metres
7–30 p. m.— 8–45 p. m.	19.82 metres, 16.86 metres
8–45 p. m.— 9–0 p. m.	19.82 metres
9–0 p. m.—10–30 p. m.	31.55 metres, 19.92 metres

NEWS at 6–30 a. m., 8–30 a. m., 9–45 a. m., 11–30 a. m. 12–30 p. m., 1–30 p. m., 4–30 p. m., 6–30 p. m. and 9–30 p. m.

WEEKLY NEWSLETTER at 3–30 p. m. on Sundays

HOME NEWS at 6–40 a. m., 12–35 p. m. and 4–40 p. m.

NEWS ANALYSIS at 9–40 p. m.

BRITISH PRESS REVIEW at 8–40 a. m. and 5–30 p. m.

RADIO NEWSREEL at 9–30 a. m. and 7–30 p. m.

PROGRAMME ANNOUNCEMENTS at 7–30 a. m., 12–40 p. m., 6–40 p. m. and 8–45 p. m.

SERVICE FOR INDIA AND THE EAST

7–0 p. m.—9–0 p. m,	16.86 m., 13 92 m.
7–45 p. m.—9–0 p. m.	19.44 m.

(Programmes in Eastern Languages)

p. m.	Thursday—	7 to 7–45	Programme In Tamil
p. m.	Friday—	7 to 7–30	Programme In Sinhalese
p. m.	Saturday—	7 to 7–45	Programme In Bengali
p. m.	Sunday—	7 to 7–45	Programme In Hindusthani
p. m.	Monday—	7 to 8–40	Programme In Tamil
p. m.	Tuesday—	7 to 8–40	Programme In Sinhalese
p. m.	Wednesday—	7 to 8–45	Programme In Marathi